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The Whole Truth—Not Selected Truth

R. H. STINCHFIELD, *Editor*

Editorial Office: 1155 16th Street, N. W., Washington 6, D. C.

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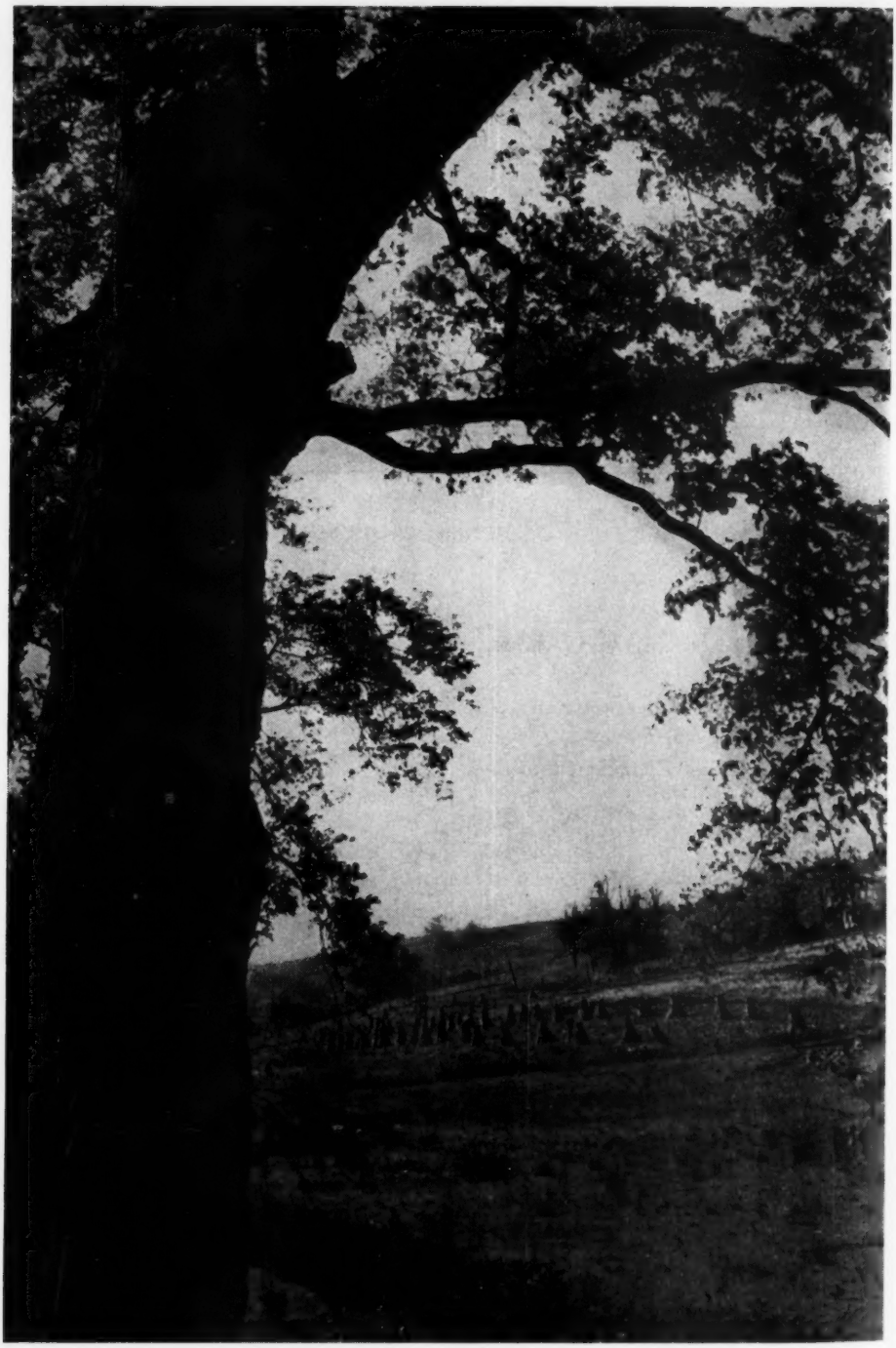

The melancholy days are come, the saddest of the year. . . . *Bryant*

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Vol. XXXIV WASHINGTON, D. C., NOVEMBER 1950 No. 9

Our Ideals in . . .

Hope and Promise

Jeff McDermid

ANY ordinary thinker who leans toward being an idealist with future plans of a nebulous kind based on a square deal for masses of the underprivileged is in a dilemma these days. He can stick tight to his philosophy and claim that events move fast, and that the idealist of today becomes the realist of tomorrow. Or he can keep silent and be shy about his hopes, for fear his associates will regard him as tinged with pink bordering on the red.

However hard it may be to retain certain inward ideals in the face of criticism and ridicule, there is a chance for all of us to pay more than lip-service to what we think is a call to duty. As one great spiritual leader once said, "The will of God is expressed in the needs of the time in which we live." There are many folks around us who would buck up and get ahead faster if they got a word of good cheer or a little lift, and we don't need to hunt far to find places where some organized idealism can be put to instant practice.

Our country has established many associations of forces led by ardent idealists. Some of them have bungled, of course, like we all do often, and a few of the outfits have been misunderstood and labeled cranks and radicals. But the Bible is full of cases like that, where the best minds and hearts have been stepped upon, stoned, and banished. Maybe some of us tossed a few rocks and called a few names ourselves, because the time did not seem ripe for opinions contrary to the main theme or for imaginations beyond the realm of reason. And besides, it is a

tough job and a thankless one to launch a boat in a swift current running in the opposite direction.

Rural America is wise to all the hardships attendant upon the launching of a new enterprise which aims to alleviate the lot of the farmer and his community. We ourselves lived in the formative years of cooperatives and rural social groups whose early efforts were much misunderstood—frequently because the pioneer farm leaders and their organizers were not diplomatic or even sincere sometimes. But in time, as the underlying good became manifest and the practical benefits of the "reformers" widened and deepened, the bitterness ceased and the enterprises were taken right into the warp and woof of the living loom and set the pattern for rural achievement and stability. That which critics and enemies of rural unity and progress were wont to call "red" has come to be a part of our national well-being. In other words, those "red" blends really turned out to be the same bright color that we are so proud to see waving along with the white and the blue.

THUS on every hand, in rural as well as in civic and industrial circles, countless germs of idealism have fused into realism. This has happened many times, and even with our state governments and public policies and more recently—since 1945—with the whole vast field of world affairs. But if those original idealists had suddenly hid themselves and quit talking and writing and spending dreary, barren years in lonely compaigns before skeptical audiences—where would our privileges be and what progress would we have made?

So this preface brings me down finally to the Food and Agriculture Organization of United Nations. We saw it organized, read its first ambitious screeds, and figured that maybe in a million years something might come of its hopeful but altogether altruistic principles. A few of us grumbled and jibed about it, as a place to provide jobs for "pinks." But a mere mild tolerance and bemused awareness of its existence was the rule. It was looked upon as harmless and hopeless.

Its deliberations and documentary output at first were not what could conceivably wean the public from its zest for athletics, bridge, or television. It had no power to go at grassroots troubles in anything but a studious and advisory fashion, nor does it yet to any extent. To be sure, it hired some good men and true out of foreign and domestic agricultural agencies and borrowed others to make up personnel of various investigating "missions" abroad, including Greece and Poland among others. They deliberated and returned, and later well-illustrated and footnoted bulletins were added to our library shelves. But truth and fact today often turn into mere historical background tomorrow under the iron heel of conquest and repression, leaving well-meant recommendations under the rubble.

Only insofar as member nations in a compact can agree on positive action will there be any noteworthy results. They do not generally agree on any decisive or unusual procedure until the governments are backed by an awakened and determined citizenship. Without the majority of the taxpayers and responsible supporters of governments showing an inclination to rid the world of unfair and vicious situations, it will not be feasible for any specialized group to accomplish real objectives in the international scene.

FAO was therefore hamstrung. It had to await the "glory day," if and when it arrived. Meanwhile all it might hope to do was to keep the spark of resolution and factual knowledge alive. Its sphere of action was very limited to a few useful, "pottering" tasks, adding to statistics like the forerunner agency, International Institute of Agriculture in Rome, and trying to recruit more sympathy for its

cause and appreciation of its aims.

By its charter, FAO is expected to shoot two ways—on more and better production of food, fiber, fish, and forests; and on the raising of the nutritional level of those two-thirds of the hungry world's people. Lack of suitable currency exchange to buy the food surplus where it could be found limited the opportunity to feed many of these distressed masses. Meanwhile,

Let us be Thankful

our country had to continue its price-support effort.

Twice FAO tried to break the jam. It tried to get the United Nations through its own agency to create a world food board, and later attempted to set up the international commodity clearinghouse. The latter was to be a method of general acceptance which would bring food to countries which need it but cannot buy for lack of hard currency. Since our dollar is the main form of hard currency, the plan would (in theory) have provided a way to move surplus stocks then piling up at great expense here—and which to some extent have been donated in order to send them abroad at all. But last year the member governments of FAO thumbed down this proposal as being too fantastic and perhaps unworkable —mostly because it was "idealistic." Our own government rejected the plan before the vote was taken and, of course, few other governments were willing to test it under the circumstances.

We have heard FAO called the "world's county agent or extension system." This is all right for a hasty nickname, but it can't work on anything like our own agricultural extension system because of at least two very cogent reasons: (1) FAO has no authority to proceed like the U. S. extension system, and a woeful lack of funds if it had the chance. (2) Very few foreign countries are equipped with extension facilities, and their farm people cannot get the money to buy the equipment, seeds, and fertilizer, even if they had all the know-how that we possess.

MORE than half of the world is in such a plight that the reform of land tenure and living conditions becomes one of the "great needs of our times." If we could put even equal effort and expense into production goods that we must divert to destruction, it might then be possible for FAO and its allies to unroll those blueprints and start building.

Some vague light in this murky atmosphere is furnished by the way in which 50 nations have pledged themselves to contribute over twenty million dollars toward matching the pool which our country has promised in Point Four technical assistance projects. It may turn out to be a slow but sure entry into the way out of this maze of unending misery. It will, unless the fund is frittered away on junkets and experiments and becomes tangled in red tape and embroidered with high-sounding slogans and tiresome reports.

This is a challenge to the skill and management of FAO, inasmuch as it will probably have to handle a large share of the funds for this technical work through the United Nations. Down-to-earth, dirty, everyday troubles must be tackled direct—disease, filth, unsanitary areas, waste, taboos, fear,

(*Turn to page* 48)

Fig. 1. Tall fescue was seeded in the fall of 1945 on this wet land where only two crops of corn had been produced in 25 years on the farm of E. L. Morton, Trenton, Ky. This grass made more than 600 pounds of seed per acre the first year. (Photo April 29, 1948)

Tall Fescue in the Southeast

By R. Y. Bailey

Regional Agronomist, Soil Conservation Service, Spartanburg, South Carolina

TALL fescue has excited more interest than any other grass or legume introduced into the Southeast in recent years. It has been planted on almost a million acres in the nine Southeastern States. A roundup of some of the things we have learned about tall fescue on farms appears to be desirable.

Two varieties—Kentucky 31 and Alta—have been the two most extensively planted in the Southeast. These varieties are so similar in appearance and growth habits that the average layman cannot tell them apart. It remains to be seen whether either will ever show any marked superiority over the other under the climatic conditions in this part of the country.

Soil Conservation Service workers who help farmers in soil conservation districts with the preparation of farm soil and water conservation plans are ever on the lookout for plants that will be useful in this kind of planning. They are attracted to tall fescue because of its strong root system and the heavy sod it makes. They also like this grass because it will grow on a variety of soils, ranging from wet lowlands to steep uplands. Fescue is growing satisfactorily on many areas of wet land where we formerly did not have well adapted grasses that we felt safe in recommending to farmers. Fescue makes a sod that is dense enough to support animals on wet land where they would mire on lighter sods.

Fescue makes effective ground cover on uplands and has shown much promise as a grass for use in soil-conserving rotations on sloping cropland. Good stands of fescue and ladino clover have come in several places where the seed

was sown and covered lightly immediately after fall-sown small grain was planted. The sod that developed after small grain was harvested in the late spring completely protected the land from erosion during the following winter. This sod would have furnished good winter pasture for livestock.

Results of several such seedings indicate that we can use tall fescue in rotations as short as three years and get about a year and a half of pasture from the grass. Grazing that could be taken from such rotations would reduce very greatly the amount of stored roughage needed for wintering cattle. The sod may be managed in such a way that almost any desired amount of plant material can be returned to the land. This stemmy grass with its coarse roots decays slowly. This slow-decaying material should greatly reduce erosion losses during the summer while the land is under cultivation for a row crop. Unfortunately, we have not had this kind of sod in studies on runoff plots, but plans are under way for starting some research along this line.

Tall fescue has been used in a number of drainageways into which water from terraces was emptied. It has given excellent protection against erosion. It also has been used along roadsides, and on several other erosion-control jobs.

Seed Production

Fescue is a better-than-average seed producer, and the seed is rather easy to harvest. This is an important factor in any new grass that is to be planted on very extensive acreages. As an example of the rate at which seed can be produced, the Soil Conservation Service bought 70 pounds of seed from B. F. Suiter of Frenchburg, Ky., in the fall of 1940 and planted it at their Chapel Hill, N. C., nursery the next spring. A small amount of seed was harvested in 1943 and the acreage for seed production was increased there and at other Service nurseries. Seed distributed to soil conservation districts from Soil Conservation Service nurseries since 1943 has totaled 126,000 pounds. This seed was distributed to almost 700 counties in the nine Southeastern States for 5-acre observational plantings.

The acreage planted with seed produced in these observational plantings on farms is an important part of the total that has been planted to this grass. For instance, Rutland Cunningham, Route 1, Killen, Ala., planted five acres in the fall of 1946 with nursery seed that he received through the Northwest Alabama Soil Conservation District. This grass was planted on good land that had been prepared and fertilized for alfalfa. Mr. Cunningham harvested 2,400 pounds of clean seed in 1947, 1,800 pounds in 1948, and 2,000 pounds in 1949. He has seeded an additional 135 acres to a mixture of fescue and clover and plans to seed fescue on 50 acres of sericea. He pastured the grass except for a few weeks before seed harvest, and topdressed it with nitrogen fertilizer each spring. Numerous similar examples could be given.

Adaptability

Space will not be taken here to give detailed instructions for growing fescue. In summary, it has produced best stands on well-prepared seedbeds, has grown more vigorously the first year when planted early in September in the Upper and Middle South and about October 1 in the Lower South. Near the coast, about November 1 appears to be the best date of seeding. This grass has grown most vigorously when well supplied with nitrogen, either from direct applications or from legumes in association with it. Close grazing and heavy trampling during the first winter have retarded root development and weakened the stands of this grass.

After it has been proved that fescue will grow on a wide variety of soils, that it remains green enough for grazing whenever it has adequate moisture, and that it makes a heavy sod that holds animals up on poorly drained

Fig. 2. Hereford cattle on fescue and ladino clover pasture on the farm of Lilly Brothers, Hopkinsville, Ky. (Photo August 17, 1948)

soils, several questions about its value as a forage plant need to be answered. Is it palatable? Is it nutritious? Will it grow satisfactorily in mixtures with legumes? Is it susceptible to disease? How long will a stand last under grazing? We have partial answers to all of these questions, but tall fescue is too new to most of the Southeast for anyone to know the final answers.

The question about palatability usually brings answers that are based on the conditions under which the grass was grazed. Stock have readily eaten green, succulent fescue that was grown in mixtures with legumes such as

Fig. 3. Twenty-seven hogs have grazed this 4-acre field of fescue and ladino clover seven months on the farm of T. R. Breedlove, Monroe, Ga. This is Class II upland Cecil clay soil. (Photo February 15, 1950)

ladino or other white clover. On the other hand, stock have not grazed coarse fescue that was left after seed was harvested, if they could get other feed that was more succulent.

We called on farmers in each of the nine Southeastern States for reports of their experience in pasturing fescue. Reports were received from 208 different farmers who pastured stock on a total of about 3,200 acres of it. This included 150 who had pastured beef cattle, 63 with dairy cows, 13 who pastured sheep and milk goats, and 13 who had pastured hogs. In most cases, the fescue was in mixtures with one of the white clovers or some other legume. In other cases, the grass was grown in pure stands for seed production, but was mowed after seed harvest and stock were turned on it after succulent new growth was produced. The grass was green and succulent in practically all cases. Pure stands were fertilized with nitrogen.

Palatability

We had only one unfavorable report on palatability. This was on a farm where a small patch of fescue was protected from grazing until summer after seed was ripe. Cattle that were turned on the coarse, tough grass refused it. This was exactly what should have been expected with fescue or most any other perennial grass. A good many of the farmers said their stock ate fescue in preference to other pasture grasses. On one Virginia farm, cattle grazed smooth brome grass in preference to fescue, but grazed fescue in preference to several other pasture grasses commonly used in that section of the State.

The question of palatability may be summed up as being one of management. When fescue has been grown with legumes that made vigorous growth, or where the grass was fertilized with enough nitrogen to make it green and succulent, stock have grazed it as well as they have other pasture grasses. Where fescue in pure stands has been left ungrazed until the leaves were coarse and fibrous, stock usually have not grazed it readily.

The nutritive value of fescue is not well known. Several state agricultural experiment stations are making studies, but very little has been published on the subject. Again going to farmers for their experience, we found that where fescue was grown in mixtures with legumes, or was well fertilized with nitrogen, stock made good gains on it.

Singletary Brothers of Blakely, Ga., pastured four steers on 3½ acres of fescue and white clover sod from November 8, 1948, to April 13, 1949. The grass and clover mixture was well fertilized. The steers were fed $12.50 worth of feed while on the grass, and they gained a total of 780 pounds. Singletary Brothers planted an additional 500 acres to fescue and clover.

Henry Vann of Clinton, N. C., pastured beef cattle for a period of 11 months on 45 acres of fescue and ladino clover. He reported that his grass and clover carried one and a half animal units per acre during this period and that the beef yield per acre was 450 pounds. Mr. Vann planted 85 more acres to fescue and ladino clover.

J. Harris Smith, Route 1, Jackson, Tenn., pastured 50 sheep on five acres of fescue from the time seed was harvested in June 1948 until the next February. He also pastured sheep again after the 1949 seed crop was harvested. The sheep grazed fescue very closely and were in good condition when they were taken off in the spring for the grass to make seed.

Dairy Forage

What about dairy cows? They are more delicate than beef cattle and are more sensitive to the quality of feed. Dairy cows might not produce a normal amount of milk on this coarse grass. Joe Strickland of Pheba, Miss., gives the following interesting report of his experience with dairy cows on fescue and white clover pasture: "I half-heartedly planted 10 acres of my worst land to fescue and white clover.

It is now the best pasture on my place. I put nine cows on this grass and clover on December 10. On March 20, I took them off so I could save seed, but in three days milk production had dropped five gallons a day, so I put them back. I took the cows off again in April and the same thing happened, so I decided it would be cheaper to let the cows eat the grass and then sell the milk and buy fescue seed. I am sold on this grass for I have seen what it does."

Mr. Strickland limed the land and applied a liberal amount of phosphate before the grass and clover were seeded. He topdressed with 300 pounds of complete fertilizer when the plants were up. He applied 200 pounds of muriate of potash on one acre. He says his cows grazed more on that acre than on any other part of the field. These results convinced him that he must apply potash along with lime and phosphate if he is to maintain a good stand of clover that can furnish nitrogen for his fescue.

E. B. Mack, a dairy farmer of North, S. C., pastured 71 dairy cows on fescue during September and October 1949. This fescue was on Norfolk and Ruston sandy loam and loamy sand. Most of the acreage of fescue was seeded with ladino clover, but part of it was in a mixture with crimson clover. Lime and liberal amounts of fertilizer were applied to stimulate vigorous growth. Mr. Mack said, "My cows pick up in milk production when I put them on fescue and drop off when I take them off fescue."

Further Evidence

Other dairy farmers have reported increases of from 15 to 40 per cent in milk production when cows were moved from other pastures to fescue. These have included herds of from a few cows to large herds. They have included high-producing cows on test. Without exception, these fescue pastures were well fertilized. There is a probability that in some cases differences between fertilizer treatment of fescue and other pastures accounted to some extent for the better results when cows were on fescue and clover pastures. In almost every case that has been reported, farmers who have pastured fescue have increased their acreage substantially.

Tall fescue has been grown in mixtures with a wide variety of legumes. Ladino clover has grown very well with this grass. A few management principles that have proved to be important in keeping these two plants in a mixture are: Selection of land on which ladino is well adapted; adequate liming and fertilizing to maintain a vigorous stand of ladino; and a rate of grazing that keeps the two plants from competing unduly with each other.

Rate of Seeding

The rate of seeding of each plant appears to be rather important. Very heavy rates of grass seeding sometimes result in overcrowding and a thin stand of clover. Excessive rates of seeding clover frequently result in thin stands of fescue. Our experience on a large number of farms has shown that under average conditions 10 pounds of fescue and 2 pounds of ladino clover seed per acre give plenty of plants for a good sod by the time the plants are a year old. Good stands have resulted where 6 to 8 pounds of fescue and 1 pound of ladino seed were planted with a cultipacker seeder on a well-prepared, firm seedbed.

Farmers who have had good results with extremely heavy rates of seeding crimson clover, ryegrass, and small grain for winter pasture have sometimes been inclined to use too much seed of fescue and either ladino or other white clovers. The perennial plants grow off somewhat more slowly than the annuals the first few months. This has led to the idea that stands from normal rates of seedings of the perennial mixture were too thin. Those who have used very heavy rates of seeding to get stands

Fig. 4. Hereford cattle on an upland fescue pasture on the farm of W. C. Camp, Gaffney, S. C. (Photo March 10, 1949)

that were comparable to their annual mixtures are likely to have trouble keeping the sod in balance after the first year. Both fescue and ladino plants spread considerably after the first year. The normal development of these plants will force a good deal of natural thinning. This thinning may sometimes be at the expense of either the clover or the grass, rather than being a uniform thinning of both. The final result may be an unbalanced sod.

Regular applications of lime and fertilizer to keep clover and other legumes that are grown in mixtures with fescue in strong, vigorous condition are ab-

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Fig. 5. Fescue seed being harvested by direct combining in Shelby County, Tenn. (Photo June 3, 1948)

Corn is a Superior Crop

By H. J. Snider

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A FIELD of corn at maturity presents to the casual observer an enormous bulk of plant growth. The height of the plant along with the large leaf spread may give an erroneous impression as to the actual proportion of grain to stalk growth. Corn under good soil conditions produces as much grain by weight as stalks and cobs. This is a more favorable proportion than that of other principal crops grown in the Midwest corn belt. It is one characteristic of corn which distinguishes it as a superior crop and may serve as another basis for comparison with other grain and seed crops.

Result of Science

This superiority in corn apparently did not just happen. It had to be sought after and studied by ingenuous men and trained scientists through many years. There is at least one paragraph in Richard Crabb's book, "The Hybrid Corn Makers," which in this connection bears repeating. "The experience of the corn breeders through the years has revealed what a remarkable job of development the selectionists of open-pollinated corn had done. The great majority of our good inbreds, the ones upon which hybrid corn rests today, were derived from open-pollinated corn. It has been from such open-pollinated varieties as Reid, Funk, Leaming, Kansas Sunflower, Lancaster Sure Crop, and other famous strains that most of the good inbreds today have come. The experience of hybrid corn breeders, searching for good inbred lines, revealed dramatically how greatly present-day American agriculture is indebted to the sturdy early settlers, corn-minded farmers and seedsmen who, by patient and painstaking selection for a century or more, had produced these outstanding open-pollinated varieties."

It is rather significant also that no outstanding inbreds have originated from corn outside the United States, as pointed out by Mr. Crabb. These facts are evidence which shows that the midwestern, the eastern, and southern farmers, seedsmen, and corn breeders have developed a superior crop. Now that the selectionists have done their good work and the corn breeders have taken over entirely there will probably be even greater progress than in the past.

A corn crop will produce as much and frequently more grain by weight than stalks and cobs. This is not generally true of other Midwest crops—oats, wheat, and soybeans. Corn on experiment fields in central and northern Illinois has averaged 50% grain, oats have averaged 48% grain, wheat 43% grain, and soybeans averaged 35% seed or beans (Table I).

TABLE I.—PERCENTAGES OF GRAIN AND BEANS IN CROPS OF CORN, OATS, WHEAT, AND SOYBEANS. AVERAGES UNDER CONTROL AND NORTHERN ILLINOIS CONDITIONS.

	Grain or Beans %	Stalks—Cobs or Straw %
Corn	50	50
Oats	48	52
Wheat	43	57
Soybeans	35	65

Fertility of Soil Causes Grain to Vary

Crop rotation and soil treatment on the Morrow Plots caused a very wide variation in the proportion of grain to stalks and cobs. With red clover in the rotation and manure, limestone, and rock phosphate added to the land, the grain made up 52.6% of corn crop. Where corn was grown every year on untreated land, the grain made up only 38.3% of the crop (Table II). The same hybrid was used throughout this test. This represents a wide variation and perhaps is an extreme example, but it serves to indicate that corn has the ability to produce grain somewhat in preference to stalks. A fertile soil gives a heavy growth of stalks, but this fertility does not grow stalks out of proportion to grain.

TABLE II.—PROPORTION OF GRAIN, STALKS, AND COBS IN THE CORN CROP GROWN ON THE OLD MORROW PLOTS 1949.

Part of plant	Untreated		Treated MLrP	
	%	bu.	%	bu.
Continuous corn				
Grain	38.3	16	46.9	57
Stalks	54.6		45.9	
Cobs	7.1		7.2	
Corn—Oats rotation				
Grain	44.8	25	47.1	104
Stalks	46.9		43.8	
Cobs	8.4		9.1	
Corn—Oats—Clover rotation				
Grain	47.6	68	52.6	104
Stalks	42.1		38.8	
Cobs	10.3		8.6	

M—manure L—limestone
rP—rock phosphate

Fig. 1. The corn on the left, grown on the Morrow plots in 1949, was from untreated land and produced 38.3% grain and 61.7% stalks and cobs. The corn on the right grew on treated land in a legume rotation and was made up of 52.6% grain and 47.4% stalks and cobs. The same hybrid was used on both plots.

Corn has been long selected and bred to produce grain with only enough stalks to support the ears and supply enough water and elements necessary for the development of grain.

Adapted hybrids are so geared to soil conditions that they will utilize large amounts of nitrogen fertilizers and give a large proportion of grain along with a high acre yield. It is true that nitrogen fertilizers usually grow a good vigorous stalk, but as a rule the stalk growth does not run wild and produce out of proportion to grain. This is demonstrated by some results on the Dixon Springs Station in 1949 where nitrogen was applied in the form of 200 pounds of 8-8-8 and in addition 837 pounds of calcium cyanamide. Here the grain was 51.4% of the crop compared to only 34.9% grain where no nitrogen was added to the corn (Table III). This Dixon Springs field is lo-

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Fig. 1. A 20-pound application of borax increased the yield of alfalfa one ton per acre on this field. That in the foreground received no borax. (Photo by Eldrow Reeve)

The Minor Element Problem

By Firman E. Bear

Soils Department, Rutgers University, New Brunswick, New Jersey

WHEN chemists report analyses of plants, microbes, animals, and man, they may include as many as 15 elements. These normally constitute more than 99 per cent of the total dry matter. In many cases, however, the limiting factor in plant and animal life is a lack of one of the more than 80 other elements that make up the remaining fraction of one per cent. This latter group contains a considerable number of what are known as the "minor-elements." Among these, the most commonly mentioned in animal and plant nutrition are iodine, cobalt, copper, manganese, zinc, molybdenum, and boron. A considerable number of other minor elements are believed to be of value for at least some species of plants and animals.

The soils of some regions are naturally deficient in one or more minor elements. The earliest example of such a deficiency in the United States was in an area around the Great Lakes, where the incidence of goiter and of the birth of hairless animals was found to be related to the iodine content of the soil. The situation is now being remedied by the use of iodized salt.

More recently, widespread deficiencies of other minor elements have been observed. Some of these occur naturally, as in the coastal plain soils along the Atlantic Ocean and the Gulf of Mexico. Others are related to erosion and consequent loss of organic matter. Still others were caused by crop removal and have become intensified with increasing agricultural age

of the land. Substitution of the automobile and tractor for the horse has played a part. Higher acre yields resulting from the use of improved seed have made greater demands on the soil's supply of these elements. Ever-greater purification of the materials that go into the manufacture of fertilizers has added the final touch to the trouble.

Minor elements may be considered either in relation to the specific needs of plants or to the requirements of the animals that consume these plants. Plants need boron, molybdenum, copper, manganese, and zinc. Animals need copper, manganese, zinc, iodine, and cobalt. It will be noted that the minor-element requirements of animals are not exactly the same as those of plants. This means that they are not necessarily met by growing high acre yields of crops. In fact, as yields of crops are stepped up their minor-element contents tend to be diluted. This applies not only to iodine and cobalt but to the others as well.

Boron

Symptoms of deficiency of minor elements in plants are now well known. Boron deficiency is evidenced by such abnormalities as brown discoloration in cauliflower heads, cracked stems in celery, black spots on beet roots, water-soaked areas in turnips, corky areas in apples, and dwarfing of alfalfa. At least 12 per cent of the land in New Jersey is known to be deficient in this element.

Molybdenum

Molybdenum deficiencies have only recently come into the picture. Large areas of land in Australia were found to be incapable of growing clover until molybdenum was applied. This element operates as a catalyst in the reduction of atmospheric nitrogen to ammonia by the bacteria in the nodules on the roots of legumes. It is also essential in the reduction of nitrates to ammonia in non-legume plants.

Fertile soils contain only between 0.2 and 0.6 pound total molybdenum in the plow depth of an acre, of which only a mere trace is soluble in water. In culture solutions, the need for this element can be met by one part molybdenum in one billion parts of water. The amount required to be applied under conditions of deficiency in the field is of the order of one ounce molybdic oxide an acre. This may be applied directly to the seed or it may be added to the soil. Field tests in New Jersey in which sodium molybdate was applied at the rate of one pound an acre to alfalfa resulted in yield increases averaging a little over 13 per cent.

In acid soil areas, the solubility of most of the minor elements is reduced by liming. Molybdenum differs from most of the other minor elements, however, in that liming increases its solubility. There is reason to believe that, in some cases, one of the most important effects of liming is that of making soil molybdenum available. It is conceivable that one ounce of molybdenum could be substituted for one ton of limestone in some cases.

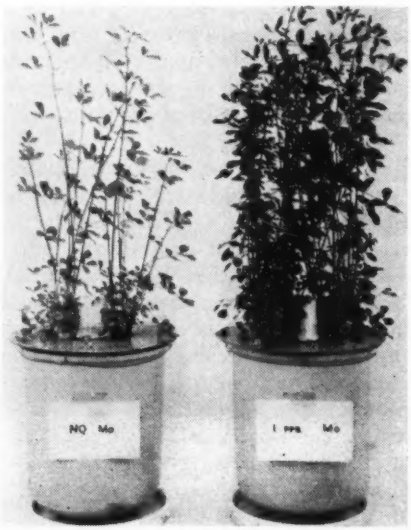

Fig. 2. Only one part molybdenum per billion parts nutrient solution made the difference in this alfalfa. (Photo by Harold J. Evans)

Molybdenum in excess of the plant's requirements tends to be toxic to animals. Most forage plants contain one or two parts per million molybdenum on a dry-weight basis. But pastures are known in which the molybdenum content of the forage is 20 parts per million or more. On such pastures, the disease known as "teartness" develops. The affected animals have severe scours, their coats become rough, they lose weight, and, unless the situation is corrected, they die. The antidote for molybdenum poisoning is copper sulfate, fed at the rate of two grams daily for mature cattle. If the forage contains sufficient copper, no toxicity effects may be noted.

Manganese

Manganese is required by both plants and animals. Its deficiency in plants is indicated by dark green veins in the newer leaves and fading of the interveinal tissues. Most soils, if well farmed, release enough manganese to meet the requirements of plants. In New Jersey, most of the manganese deficiency noted to date has been in connection with over-liming. In certain market-gardening areas, deficiency of this element is so widespread as a result of the excessive use of lime that farmers regularly apply 50 pounds manganese sulfate an acre as a part of their standard fertilizer program.

The manganese content of plants may range from five parts per million to several thousand parts. Analyses in our laboratory of over 200 samples of vegetables from 10 states showed that those grown in the West had much lower manganese contents than those from the more acid soils of the East and South. It is conceivable that some foods and feeds contain too much manganese. The amount required by animals is very small, perhaps of the order of six parts per million of dry weight of feed. The manganese requirements of man are not known.

Manganese deficiency in animals is best known in "perosis" or "slipped tendon" disease of poultry. This is characterized by enlargement of leg joints and displacement of tendons and by arrested growth of leg and wing bones and of those of the spinal column. Eggs of manganese-deficient hens hatch slowly. Pigs fed a ration low in manganese tend to develop enlarged hocks and crooked legs. Wheat bran is a good source of manganese.

Copper

One of the most easily recognized copper-deficiency symptoms in plants is dieback in citrus. This is characterized by death of new growth and formation of many side branches below the dead portions. Gum pockets develop between bark and wood and the fruit shows brown excrescences. Tomatoes growing on copper-deficient soils are dwarfed, the edges of the leaves roll inward, and the plants have a bluish-green appearance. In onions, copper deficiency is evidenced by pale yellow bulbs that lack solidity. Most plants contain less than 10 parts per million copper, on a dry-weight basis, and they normally show copper toxicity at 30 parts per million or more.

Copper deficiency in animals is characterized by a form of anemia. In copper-deficient areas in Australia, newborn lambs and young sheep suffer from paralysis, which can be prevented by feeding the ewes copper sulfate. In the absence of copper, iron can be absorbed and stored but it cannot be utilized. The copper functions as a catalytic agent or as a necessary part of an enzyme system. The livers of new-born animals normally contain more copper than those of older animals. The daily requirement for humans is set at from one to two milligrams copper a day.

Zinc

Zinc deficiency in plants was first observed on pecan trees over a wide area in the Southern States. The tops of the trees died. Similar deficiencies were noted in tung trees. The most

easily recognized symptom of zinc deficiency is shown by corn, which, in the absence of adequate amounts of zinc, produces what is known as "white bud." Plants vary considerably in their zinc requirements, corn, pecans, and citrus having a greater need for this element than alfalfa. The zinc content of plants is usually between 25 and 75 parts per million dry weight. Some weeds, notably ragweed and lamb's quarter, appear to be accumulators of this element. Such weeds may have value as cover crops for plowing-under purposes on zinc-deficient soils.

The human body contains something like two grams zinc, more than of any other minor element. Zinc-deficient animals tend to develop hyperkeratosis, or thickening of the skin, with loss of hair. It has been suggested that X-disease of cattle might be due to a deficiency of this element. Vegetation from several farms on which animals were affected by the disease were found to range between 13 and 25 parts zinc per million dry matter. The evidence is entirely too limited, however, to permit drawing any very definite conclusions.

Although manganese, copper, and zinc are essential to animals, any deficiency in the food or feed would normally be met by way of the soil, since plants also require these elements. Nevertheless it is now common practice to add about six ounces manganese sulfate to every ton of poultry feed as a protective measure against perosis, and small amounts of copper sulfate or carbonate are added to hog feeds. Occasionally manganese and copper sulfates are put in dairy-cow feeds and zinc sulfate or carbonate as well. It has been shown that pigs with no opportunity to root in the soil often suffer from deficiencies of one or more of these elements. The remedy is found in painting the sow's teats with a solution of their salts.

Cobalt

The cobalt content of plants is normally less than 0.1 part per million dry matter. Insofar as is known, the element is not an essential plant nutrient. But it is conceivable that more careful work with this element will show that the quantities contained as impurities in nutrient-solution chemicals and in the containers in which the plants are grown are adequate to meet

Fig. 3. Too little, just enough, and too much manganese for soybeans. Those on the left received no manganese, and those to the right were supplied with manganese at the rates of 0.1, 2, and 5 part per million nutrient solution, respectively. (Photo by Paul D. Christensen)

all their needs. Extreme care is necessary to avoid contamination with the mere traces of this element that may suffice to meet the needs of plants.

Cobalt deficiency in animals is widespread. It is known variously as "pine disease," "Morton's Main disease," "bush sickness," "salt sickness," "Burton ail," and "Grand Traverse disease." The common symptoms are depraved appetite, progressive emaciation, anemia, retarded sexual development, and muscular atrophy. The spleen shrivels. The hair or wool becomes harsh. Sheep are affected more than cattle, and young stock more than old. In some cases, the only evidence of the disease may be the very slow growth of animals or their failure to gain weight.

The passing point for cobalt in soils is of the order of two parts per million, or about four pounds an acre to plow depth. Good forage should contain 0.07 part per million cobalt, on the dry-matter basis, for sheep, but somewhat smaller amounts apparently suffice for cattle. The evidence indicates that legumes are higher in cobalt than grasses and that they seldom contain less than 0.07 part per million cobalt. In proportion as legumes are contained in the forage, cobalt deficiency is less likely to occur.

The point here raised is as to whether it is better to add cobalt to the soil so that it may become an organic part of the plant, or whether it can be fed directly to animals. The normal rate of application of cobalt sulfate to pastures is two to four ounces an acre annually, in comparison with about two grams of the salt that is being added to each ton of grain feed for cows. The economy of putting it in the feed is apparent, the cost being of the order of ¼ cent a ton.

Insofar as cows and other ruminants are concerned, direct addition of the mineral salt to the feed is entirely satisfactory. The cow's rumen is a living factory where feed is digested and new products are synthesized. In this environment, vitamin B12, of which cobalt is an essential constituent, is produced. In the case of man and other non-ruminants, the bacteria of the lower intestine may accomplish much the same purpose as those in the rumen of the cow. Some of the antibiotics, by reducing the activities of the microorganisms of the intestinal tract, have been shown to lower the synthesis of certain vitamins, with resulting faulty nutrition. It is of interest in this connection that, by adding cobalt, streptomyces griseus produces not only streptomycin but vitamin B12 in commercial quantities as well.

Variety

One of the best means of preventing minor-element deficiencies in man is through the eating of a variety of foods from a variety of origins. When one considers the many kinds of plant products that find their way to the table, it would seem that all man's minor-element requirements would be adequately met. It must be admitted, however, that this is a hit-and-miss system and that, for the poorer classes, the careless, and the uneducated, it may not work.

Fortunately we consume large amounts of meat, eggs, and milk, all of which have protective value in terms of these elements. Animals effect a screening process by which non-essential and injurious elements may be eliminated and needed elements concentrated. The animal serves as an "official taster" for man, and it may lose its life in the process. If meat, eggs, and milk are to be produced economically, all the needs of the animals must be met, and their mineral needs are quite similar to those of man.

The livers of animals serve as storage agents for minor elements, and this no doubt accounts in large part for the fairly widespread practice of eating liver regularly once a week. The same applies to the weekly eating of fish. Salt-water fish would certainly have

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Tree Symptoms and Leaf Analysis Determine Potash Needs

By G. D. Worswick

Farm Adviser, Santa Clara County, San Jose, California

A GOOD annual crop of fruit tends to remove permanently more potassium from the soil than do most of the common field crops.

There is usually more nitrogen than potassium in the leaves and wood of fruit trees, but all leaves and some of the wood are returned to the soil. The fruit, however, may contain much more potassium than nitrogen, and a bearing orchard is apt to deplete the potassium supply more than it depletes the nitrogen supply or the supply of any other element.

Although fruit crops deplete the potassium supply in the soil as fast, or faster than they deplete the nitrogen supply, there are, in America at least, many more orchards in which trees will show response to fertilization with nitrogen than there are in which they will show response to fertilization with potassium. This is partly because the supply of potassium, a constituent of the rock from which the soil was formed, is apt to be the larger and partly because the loss of potassium from the soil by leaching is slower than the loss of nitrogen by leaching and denitrification.

In a considerable number of soil areas, however, trees will respond to fertilization with potassium, and more orchard areas are constantly developing potassium deficiencies because of the fairly rapid rate at which potassium is removed from the soil.

The most severe and obvious potassium deficiencies are apt to be in soils containing exceptionally large quantities of other cations (positive ions), especially calcium and magnesium. Excessive amounts of calcium and magnesium will reduce the uptake of potassium. Poorly aerated soils with large percentages of fine clay particles also may be unable to supply enough potassium even though they contain large quantities.

Fig. 1. Potassium-deficient French prune tree —Gilroy, California, area. Note sparse foliage and dieback in upper part of tree.

Most helpful information concerning the potassium supply of trees has been obtained by study of visual symptoms of potassium deficiency, especially leaf symptoms. Trees that make good growth in the spring and early summer may show a leaf crinkling, and in midsummer to late summer serious leaf

injury. The most general of these symptoms is a dying (scorching) at the margins or along the mid-rib or veins. On trees of some varieties, a creamy yellow shading into yellow-green may precede this scorching.

Dying-back of shoots in late summer or autumn is, in some orchards, another important symptom of potassium deficiency. In some soils trees that show in late summer rather serious leaf injury from lack of potassium may make good spring and early summer growth; in others there may be a serious dwarfing much like that from copper deficiency. In fact, sometimes in some species, deficiency symptoms of copper, manganese, and potassium are not easily distinguished by mere orchard observation.

It must also be noted that other factors, such as crown gall, crown rot, sour sap, oak root fungus, and excess sodium, may cause dieback. Trees so affected will also carry chlorotic (yellowing) mottled leaves in varying degrees of intensity.

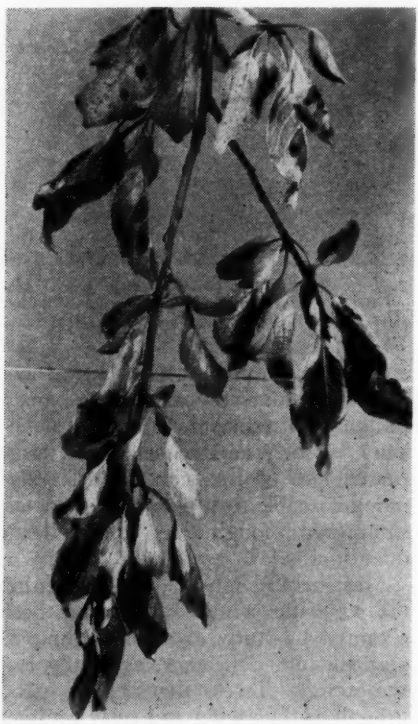

Fig. 2. Twig showing leaf curling and scorching, and small size of leaves typical of potash deficiency on prunes—Morgan Hill, California, area.

Fruiting tends to accentuate potash injury in leaves and branches. Trees of some species tend to drop nearly all the blossoms and young fruit, but trees of others, such as Agen prune, may set rather heavy crops. Potassium moves to the fruit to such an extent that on a soil not too deficient in potassium for excellent growth of young trees, a heavy crop may cause severe potassium-deficiency symptoms in the leaves and dying-back of the shoots or even larger parts of the branches.

Slender, peaked, short growth, with short internodes and needle-like points, and chlorotic leaves having interveinal mottling, a convex rolling, and a buckskin to bronze color on the upper side are characteristic symptoms of potassium deficiency in French prunes. Where an extreme deficiency exists, dieback of shoot wood and marginal scorch of the leaves may be present with sub-normal crops of poor quality fruit.

It was not until recently that vegetative symptoms in apricots suspected of being potasium deficiency were reported. This recent discovery in Santa Clara County has lead to the detection of low potassium areas in two additional widely separated locations in the County and another in San Mateo County.

These apricot trees showed severe dieback in the tops and short, spindly growth throughout the tree, the leaves being chlorotic and mottled with severe marginal scorch and irregularly shaped necrotic spots (dead spots). The outstanding symptom was evidenced by a cupping of the leaf which appeared much like an excess sodium characteristic with the exception that the potassium-deficient leaf retained its pointedness whereas the leaf affected by sodium generally shows little or no point. In these instances, yield was impaired and quality of fruit poor.

It is much more difficult to recognize potassium deficiency in the pear,

although symptoms may be found by close and careful examination. The pear makes little new growth and the leaves become yellowish-green with brownish discolorations around their margins. In some cases, leaves roll and a grayish-green discoloration appears around the margins, while others have a reddish tinge.

Where the potassium deficiency is acute, a marginal scorch may be found and the yield will be below normal, the greater portion of which will be sub-standard in size. Chlorotic effects and marginal scorch must not be confused with somewhat similar symptoms where lime-induced chlorosis (iron deficiency) is present. The latter occurs in high-calcium soils, such as soils of the Sorrento series, Bowers clay, and Sunnyvale clay loam.

An abundant nitrogen supply tends to accentuate a potassium deficiency, possibly in part because nitrogen increases growth and thereby increases the potassium requirement of the tree. This condition developed in one prune orchard in Santa Clara County where a heavy application of nitrogen on low-potassium soil resulted in increased leaf scorch and very severe dieback the following year.

In the endeavor by soil scientists and pomologists to determine the causes of erratic tree behavior with respect to soil fertility, it is quite logical to turn to an analytical method that will give some measure of the chemical elements that the tree is able to take from the soil.

It has very properly been said that "The Plant Speaks," which is just what happens when fruit-tree leaves are subjected to chemical analysis. The results of such an analysis are expressed in percentages on a dry-weight basis and by correlation with the known visual symptoms serving us as a guide to locate the disturbing factor, whether it be a chemical deficiency or excess.

Recognizing these important facts, the Pomology Division has set up a leaf-analysis laboratory with the most modern and highly developed equipment for the purpose of making statewide studies. This work is under the guidance of Dr. Omund Lilleland, Pomologist of the Agricultural Experiment Station, Davis, California.

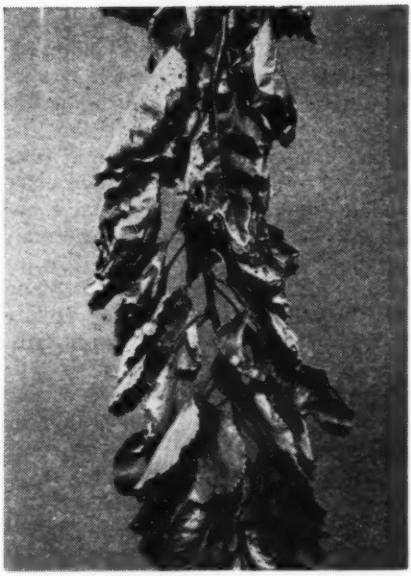

Fig. 3. Scorched leaves on new growth of apricot trees which have run short of potash—Eastside area, Santa Clara Valley.

Fig. 4. Making a heavy application to potash-deficient apricot trees—Eastside area, Santa Clara Valley.

After a great volume of leaf-analysis work in various tree fruits and nuts, certain standards have been determined for normal trees bearing average crops of good quality. By comparing the report of analyses of leaves from trees suspected of too low an uptake of plant food for best growth, or excessive uptake of harmful chemicals, an interpretation can be made. From this information a fertilizer test can be made in the orchard concerned to actually prove the efficacy of the treatment indicated by the leaf analysis. We have recommended that all growers having potassium-deficiency symptoms in their orchards put in small test plots for observation, and a few have done so with striking results.

It is recommended that potassium be applied in massive amounts in the order of 25-30 pounds sulfate of potash per tree, as generally fruit trees are slow in their uptake. However, two pear growers and two French prune growers obtained a satisfactory response the first crop following the potassium application made during the dormant season. Leaf color was corrected or improved, shoot growth was normal, and fruit yield and sizes were increased to normal.

French prune trees in a Santa Clara Valley orchard showing severe symptoms of potash deficiency showed this analysis (dry basis) with samples taken in July: Potassium in the leaves—0.38%.

Two years after one massive treatment of 25 pounds sulphate of potash per tree, the trees made a very good recovery in foliage and growth condition and, of course, an equal recovery in size and quality of fruit. At this time the analysis (dry basis) on a comparable leaf sample was: Potassium in the leaves—0.89%.

We do not feel that the optimum build-up of potassium has yet occurred in these trees, even though the improvement was remarkable. The orchard is still in a zone of potassium deficiency, in our opinion, until the leaf level reaches 1.5% potassium.

Hardy pear trees in an orchard in this Valley were exhibiting severe symptoms such as those described for potassium deficiency, and a leaf sample collected in late July showed this analysis: Potassium in the leaves—0.14%.

A block of these trees was treated with 15 pounds sulphate of potash per tree and an outstanding recovery has

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Fig. 5. Apricot trees in last stages of potassium deficiency—Los Altos, California, area.

Insect Control Goes With Cotton Fertilizer Plan

By Roy H. Anderson

Agronomist, North Texas Supply Co., Paris, Texas

IT has become increasingly important to consider insect control when planning for maximum cotton production. Through a cooperative F.H.A. farmer cotton dusting, fertilizing demonstration in 1948, twelve farmers in Lamar County, Texas, averaged 422 pounds of lint cotton per acre as compared to a 174-pound average yield on their check plots. The entire County had an average of 166 pounds of lint per acre in 1949.

These twelve farmers each had five acres that had the fertilizer applied as recommended for the specific farm by N. A. Cleveland, F.H.A. County Administrator. In addition, these five-acre plots received two applications of the organic poisons, 3-5-40 or toxaphene, at a stage just before the cotton plants put on squares. This is what is known as presquare dusting, just as the name implies. The theory behind this method of dusting is based on the fact that the over-wintering weevils, fleas, and thrips can be very easily killed before there are any squares to lay their eggs in. This assures the setting of a cotton crop, since there are relatively no insects present to damage them. Our farmers have found that if they can save that first crop of squares and grow them to maturity, they can be pretty well assured of a fairly profitable cotton crop.

This was the experience of these demonstrator farmers, with five of the twelve making over 500 pounds of lint per acre on their five acres. In checking the results of the other farmers, late planting and poor stands seem to have affected the majority and probably were the main contributing factors in their not making the bale per acre that some of the others did.

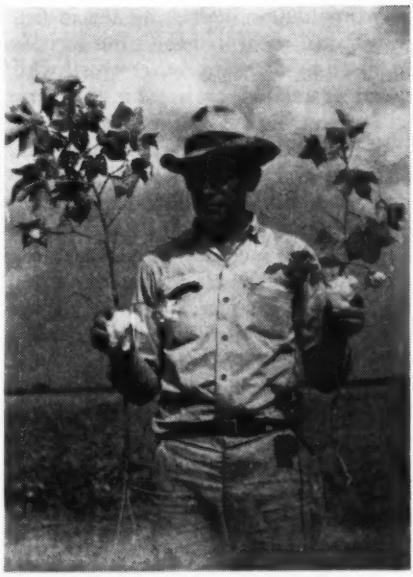

Fig. 1. Fertilizer response but poor insect control.

Sidney S. Clark topped the Lamar County group and also the State with his 681.7 pounds of lint per acre. Compare this with his check plot that was not fertilized and received no poison until late July. He did not pick the check plot.

His treatment on the five-acre demonstration plot included the application of 100 pounds of 5-10-5 and 100 pounds of 4-8-8 on land that had previously been in a phosphated cover crop. Clark dusted as the other demonstrators did,

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Farming With Green Manures

(A Review of an Old Book)

By George R. Cobb

Salisbury, Maryland

A BOOK printed in 1880 and written by C. Harlan on the subject "Farming with Green Manures" not only provides an interesting and instructive discussion of that topic but includes suggestions of many other worthwhile practices related to life on the farm. This book is the 6th edition revised and enlarged. Mr. Harlan owned and operated a large farm near Wilmington, Delaware, and most of his advice is based on his experiences on this farm although he includes quotations from old-time writers and experiences of farmers of his time.

Mr. Harlan anticipated Faulkner's "Plowman's Folly." He warns us that when we plow under a great mass of vegetation that we must be careful that we do not "roof" over the subsoil. If we do, he continues, we must plow it again and harrow and pulverize it well before seeding a crop. He, like Faulkner, is opposed to too much plowing of land as he says, "It is the too frequent breaking up of poor land that keeps the farmer poor." Whether it would be better to plow the mulch under in the spring, or only disturb the friable and crumbling mould enough to receive the seed and young plants from the hotbed must be a matter of one's own or another's experience, he believes, but he prefers the latter method.

It would seem that he "stole some of the thunder" from present-day agronomists when he advises having the soil in such condition that air can get to the roots of the plants. The more we introduce air into the roots of growing plants, he says, the less need we will have to send to South America for guano. It is the oxygen of the air that supports combustion and the roots of all growing plants must absorb oxygen or they cannot grow. He, like agronomists in Nebraska and elsewhere, is an advocate of trash farming for he writes, "If we are satisfied upon careful examination that the clover is dense and deep enough to prevent all weeds from growing, we may put in the corn in the following manner—open a space in the mulch the size of your hand and with a hoe scrape a hole less than two inches deep, then let an assistant drop in three or four grains of corn, cover it one inch and tred the hill as you leave. After this you will have nothing to do till the crop is ready to cut."

Shallow Cultivation

At the present time farmers are advised to cultivate corn as little as possible—just enough to control weeds in the early part of the season. This would seem to be another old story, for back in 1841 the Cultivator tells of a Mr. Williams who grew 158 bushels of corn per acre without cultivation. His method was to plant the corn and then with sharp hoes and with a scraping motion cut the weeds—no other cultivation. And he attributes much of his success to the fact that the roots of the corn were not disturbed during the growing season.

As a further indication that perhaps Mr. Harlan was in advance of his time is his advice to apply fertilizer to the cover crop. In this he agrees with Dr. Wolf and other soil men and agronomists.

In the olden days, apparently, a farmer who made money spent this hard-earned cash for more land. Mr. Harlan quotes Alderman Mechi, who is cited as England's "Model Farmer,"

as saying, "I have noticed a very money-getting farmer in my neighborhood who never keeps any livestock, except a couple of cows, and who never buys any feeding stuffs or manures. He keeps his land clean and fertile by plowing in green crops. I know that he makes money for he often purchases land."

To say that Mr. Harlan was enthusiastic regarding manures would be putting the case mildly, as he might be considered a fanatic on the subject and it might be well if there were more such fanatics in our country. He writes that green crops have a manurial power equal, if not superior, to every other mode of improvement. Their roots penetrate the earth and open millions of channels which permit the air with all of its rich constituents to act upon the subsoil and improve it not only by compelling the decay of vegetable matter but by entering into new compounds and thus becoming available food for plants. The deep roots of the green manures change the color, the texture, and the quality of the subsoil which stable manures cannot do. Green manures supply organic matter and poor land is the result of a lack of organic matter, not of minerals. The ash of agricultural plants consists of the phosphates, sulphates, silicates, and carbonates of potash, soda, lime, and magnesia with small amounts of oxide of iron and manganese and alkali chlorides.

Many Values

Low production on the farm, Mr. Harlan claims, is caused by a lack of organic matter. Humus, he says, is more than four horses to a plow. It makes the earth mellow, it loosens up its texture so that the air and roots can penetrate, it changes the color of the soil, it converts the nitrogen of the air into nitric acid and ammonia, it absorbs and retains moisture better than anything else, it holds the constituents of plant food in its millions of capillary vessels, and it makes the soil so friable that it is never too dry or hard to plow and seldom too wet to till.

Another fact in favor of green manures is the cost. Writing of red clover as a green manure, he says that here we have a green manure that costs but a trifle over three cents per ton and which is more valuable, ton for ton, than stable manure. It will take 360 tons of stable manure, for example, on 20 acres to supply as much nitrogen as we have in a single crop of clover and not a cart nor horse nor fork of any kind was required to spread it evenly over the whole field. The time-saving factor is important, since with green manures there is no labor spreading manure or fertilizer. All vegetation, according to Mr. Harlan, has its nitrogen in the form of albuminoids and nothing but the decay or the complete decomposition of these protein bodies and the conversion of their nitrogen into nitric acid and ammonia will render them available as plant food.

Based on his statement that "were all the merits of red clover emblazoned in letters of gold on a large canvas they would fail to convey to the mind a full estimate of its true value" one would believe that Mr. Harlan had only one crop in mind as a green manure. But although he does consider clover one of the best, he also considers corn, buckwheat, white mustard, rye, and even turnips as very valuable green manures.

Corn Best Crop

One requisite of a green manure is bulk or quantity and he, like many present-day agronomists, considers corn as one of the best crops to furnish bulk and quantity of green matter. If seeded thickly and two crops grown in a season, corn will furnish a large amount of green matter. He has grown and turned under from 30 to 45 tons per acre. S. E. Todd in his Farmer's Manual writes in the early '80's, "Some farmers contend that clover plowed under is the cheapest manure that can be made. It is a great fertilizer, but I believe that a soil can be renovated sooner and at less expense with Indian corn than

with clover because a much larger quantity is turned under yearly."

Mr. Harlan states that one ton of green corn contains 6 pounds of nitrogen, 2½ pounds of phosphoric acid, 9 pounds of potash and 1,600 pounds of water and that two crops a year, each containing in tops and roots about 20 tons per acre, will manure the land well. The second crop may be allowed to stand over winter and then be rolled down in the spring or better yet it may be cut in the fall and let lie where it falls to be turned under in the spring. When seeding corn for a green manure there is some question as to the number of grains to sow per foot of row. Some old-timers advise from 20 to 30 while others would drop 50 or more per foot. The Genesee Farmer in 1865 says that a Mr. Peters contends that the amount of corn fodder one can grow on an acre is truly fabulous as it is not unusual to grow 200 tons and he thinks it possible to produce 250 tons with "care and a good season."

Other Crops

There are many farmers and agronomists today who are wondering if we have not "missed the boat" in not using more buckwheat as a green manure. Mr. Harlan would agree with them fully in that they have failed to realize the value of this crop as a green manure or even as a hay. The American Agriculturist in 1867 stated that buckwheat affords one of the most valuable green manures to be used on light, leachy land. Colman, in his European Agriculture, 1846, feels that buckwheat is certainly the most economical and convenient manure that the farmer can employ. The Editor of the Theatre of Agriculture says, "We cannot too much recommend, after our old and constant practice, the employment of this precious plant (buckwheat) as a manure."

According to Mr. Harlan, three crops of buckwheat can be grown on the same piece of land in one season and these three crops will yield 45 tons per acre. And as usual he figures on a field of 20 acres so that on 20 acres you will have 900 tons of green matter. Applying his figures that one ton of green buckwheat contains 8 pounds of nitrogen, 3 pounds of phosphoric acid, and 11 pounds of potash these 900 tons would furnish 7,200 pounds of nitrogen, 2,700 pounds of phosphoric acid, and 9,900 pounds of potash which translated into terms of stable manure would mean that you would have to apply around 720 tons of manure to supply the same amounts of N, P, and K. Again we have no labor costs for spreading the green manure or removing it from the stables as we do with stable manure.

Apparently rye was considered just as valuable a green manure in 1847 as in 1947, for Mr. Harlan writes very highly of it as one of the best crops for that purpose. According to him, one ton of green rye contains 11 pounds of nitrogen, 4½ pounds of phosphoric acid, 12½ pounds of potash, and 1,400 pounds of water. In 1843 the Cultivator carried a story of a farmer who wrote: "Were my only object the rapid improvement of my soil within the shortest space of time, I would first sow down thick with rye which I would plow under just before time of ripening and would then sow 1½ bushels of corn per acre thus plowing under in the same season a heavy coat of rye and corn which in this short space of 12 months will equal, if not surpass, any benefit which can be derived from clover in two years."

According to Mr. Harlan, rye in the green state is equal, ton for ton, to stable manure with one small exception —the latter has a half pound more of phosphoric acid than the former. The rye crop is growing when no other crop except wheat could occupy the land, it protects the field from washing during the winter, and it absorbs the soluble minerals and the ammonia and nitric acid that might under other conditions be lost. The crop may be plowed down for a crop of corn or it may be cut down just as it blossoms and left as a mulch on the ground. A second crop will then grow up through it nearly

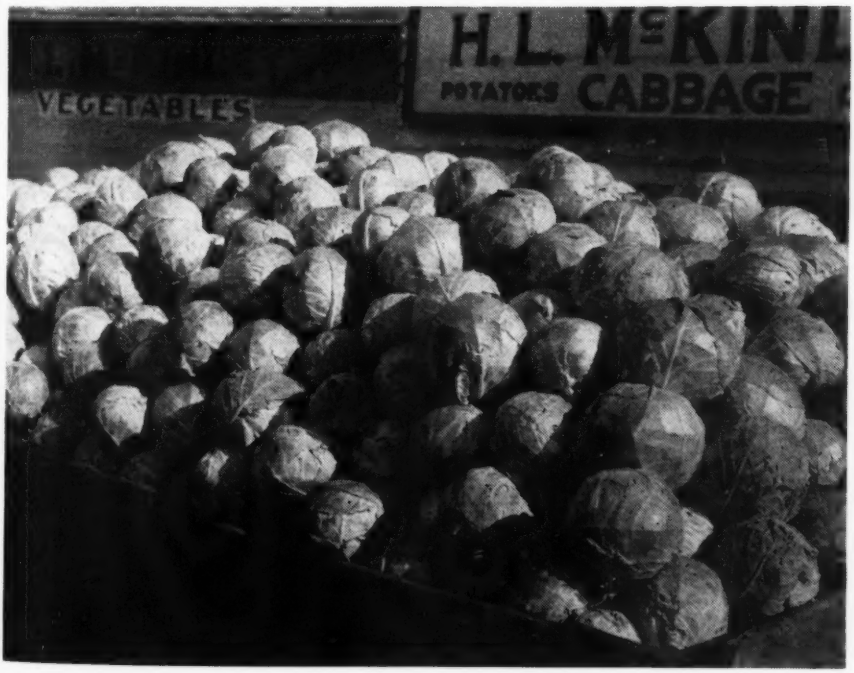
(*Turn to page* 45)

PICTORIAL

Snow—It Can Happen Anytime Now!

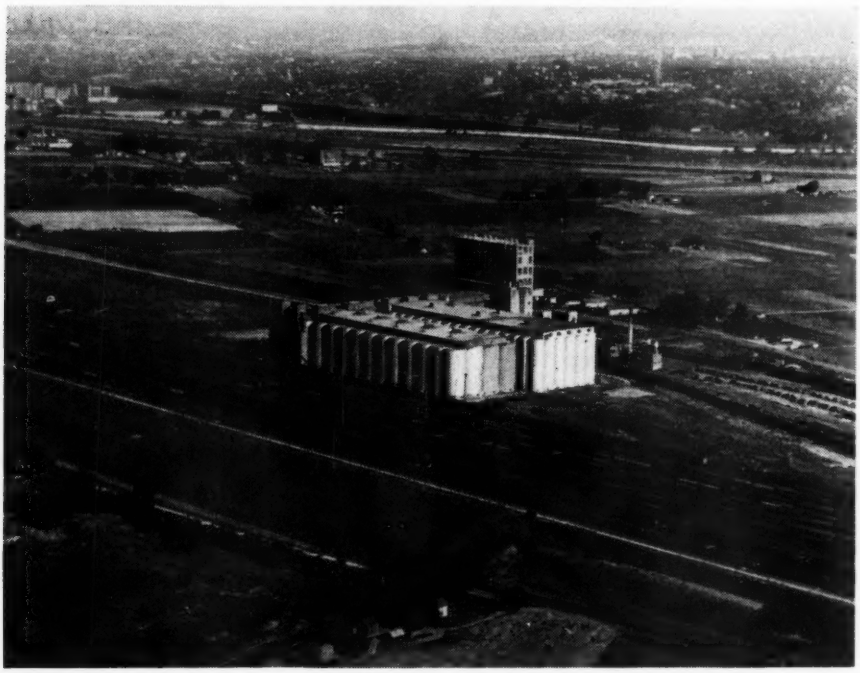
Among the La

Be Harvested



Above: Storing corn in temporary cribs is being repeated again this year.

Below: Grain terminal, Turner, Kansas, said to be largest in the world.



The Editors Talk

The Science of Farming

In Cincinnati, Ohio, October 30 through November 4, nearly 1,100 highly trained agriculturists and research men gathered to discuss and digest the latest problems in profitable soil and crop management. The occasion was the 42nd annual meeting of the American Society of Agronomy and the 15th of the Soil Science Society of America. Faced with the demands which may be made upon our agriculture in the event of another international emergency, these men appeared more than ordinarily serious in their consideration of ways and means for getting the results of research into practical application—into the science of farming.

To bear out this observation and in evidence of the tremendous interest in grassland farming developing on the part of farmers throughout this country, the first day of the convention was devoted to a general session on this subject. This was a new feature and the large audience listened to such practical discussions as "Fertilization and Nutrition of Grasslands," by Firman E. Bear, New Jersey Agricultural Experiment Station; "Building Soil Tilth with Grasslands," by G. N. Hoffer, American Potash Institute; "Grass and Legume Mixtures Essential for a Grassland System," by D. F. Beard, Bureau of Plant Industry, U. S. Department of Agriculture; "Grassland Farm Management," by D. Howard Doane, Doane Agricultural Service; "Grassland Mechanization," by F. W. Duffee, University of Wisconsin; "The Economics of Grassland Farming," by Herrell DeGraff, Cornell University; and "Observations in a Recent Grassland Survey," by D. R. Dodd, Ohio State University. It also listened to two "dirt" farmers—Paul Strickler, Waterford, Virginia, and Willis Stout, Louisville, Kentucky—who told how they had applied science in "My Grassland Program and How I Built It."

Other features of this year's meeting included programs for two new divisions of the societies—the Plant Nutrients Division and the Agronomic Application Division. In one session of the former, a look into the future was presented in "What Problems Should Plant Nutrient Research During the Decade of 1950 Be Designed to Solve?" by Richard Bradfield of Cornell University. A panel following put special emphasis on minor element needs of soils, plants, animals, and man; adequate consideration of the influence of soil organisms on the functioning of roots; high fertilization of crops, high yields, and nutritive value; and fundamental and applied research in soil fertility. At the close of this panel, Dr. Bradfield made a strong plea for coordination and cooperation in all fields of agricultural research in order to attack more efficiently the problems facing agricultural scientists, thus permitting their more rapid solution and the putting of the results into actual usage. The Agronomic Application Division spent two full afternoon sessions on pasture management, in deference to the trend to put more and more of our acreage into grasslands.

One of the drawbacks to progress in agriculture always has been the reluctance of farmers to adopt new practices. What father did was good enough for son. The successful farmer today is a new type, for farming has become a complex

science and the scientist not only is versed on the well-known ways of doing things but is looking for new means of accomplishment. It is fortunate that we have national organizations of research workers who in their large annual meetings as well as in sectional meetings can keep ahead of the problems which confront the successful farmer—the farmer who wants to apply more and more science to his farming.

Soil Conservation Is National Defense

"Soil conservation is an indispensable part of our first line of national defense. The other indispensable part of our first line of national defense is, of course, strong soldiers, guns and bullets. The two—adequate food from productive land for adequate defense—are mutually sustaining; one cannot exist without the other. If we lose our soil, there will be little to defend, and only hungry soldiers for defense."

Thus, does Dr. Hugh Bennett, Chief of the Soil Conservation Service, place due emphasis on the fertility of the soil, from which all of our strength, personal and national, must come. Although this concept has long been realized by thinking people, its repetition over and over again is most commendable in these times. National defense, involving tremendous costs and resulting sacrifices, is uppermost in everyone's mind. In the pressure to build it up as quickly as possible, the basic principles must not be forgotten. By nature of its vast coverage, the Soil Conservation program has taken time and is years from completion. However, the progress has been steady and satisfactory.

In a recent report, Dr. Bennett states that the rate of progress is very much greater per dollar spent today than it was in the earlier years, and the trend is steadily upward. While we admittedly are not moving fast enough, we are, nevertheless, moving ahead at a rate that is anything but discouraging. At the end of the first seven years of work, in 1941, the Service had directed the conservation treatment of 26,600,000 acres, an average of 3,800,000 acres annually for the first seven years. The total soil conservation job, in 1941, comprised all lands classified as "in farms," or 1,098,000,000 acres (Census 1945). This does not include areas occupied by roads, lanes, farmsteads, etc.

During 1942 the principal conservation measures were applied to approximately 5,000,000 acres (in soil conservation districts); in 1949 the same kind of treatment was applied to 22,000,000 additional acres. This was an increase of 340 per cent—yearly 4½ times as much work done—with operating facilities increased during this second seven-year period by only 43 per cent.

But there is still a long way to go, Dr. Bennett says, and we are still losing great quantities of soil. However, we have learned to control erosion on practically all kinds of land, and we are controlling it at a much faster rate than the public realizes. He sees no reason why we can't continue to build up momentum and believes, given adequate facilities, that we can get the job of applying the basic conservation measures to the land completed by about 1970—around 20 years from now. As to finishing the job, actually there is no end to it, because when the basic conservation measures have been applied to the land there will be the continuing task of maintenance. This is true of all the works of man. If not maintained, they eventually disappear through neglect.

This, then, is a national defense program looking well into the future. It must not be overlooked, and the importance of conserving and maintaining the fertility of their soils should constantly be kept before our American farmers. In this is a considerable measure of assuredness that we shall be able to meet emergencies as they befall us.

Season Average Prices Received by Farmers for Specified Commodities *

Crop Year	Cotton Cents per lb. Aug.-July	Tobacco Cents per lb.	Potatoes Cents per bu. July-June	Sweet Potatoes Cents per bu. July-June	Corn Cents per bu. Oct.-Sept.	Wheat Cents per bu. July-June	Hay[1] Dollars per ton July-June	Cottonseed Dollars per ton July-June	Truck Crops ....
Av. Aug. 1909–July 1914....	12.4	10.0	69.7	87.8	64.2	88.4	11.87	22.55	....
1925.....	19.6	16.8	170.5	165.1	69.9	143.7	12.77	31.59	....
1926.....	12.5	17.9	131.4	117.4	74.5	121.7	13.24	22.04	....
1927.....	20.2	20.7	101.9	109.0	85.0	119.0	10.29	34.83	....
1928.....	18.0	20.0	53.2	118.0	84.0	99.8	11.22	34.17	....
1929.....	16.8	18.3	131.6	117.1	79.9	103.6	10.90	30.92	....
1930.....	9.5	12.8	91.2	108.1	59.8	67.1	11.06	22.04	....
1931.....	5.7	8.2	46.0	72.6	32.0	39.0	8.69	8.97	....
1932.....	6.5	10.5	38.0	54.2	31.9	38.2	6.20	10.33	....
1933.....	10.2	13.0	82.4	69.4	52.2	74.4	8.09	12.88	....
1934.....	12.4	21.3	44.6	79.8	81.5	84.8	13.20	33.00	....
1935.....	11.1	18.4	59.3	70.3	65.5	83.2	7.52	30.54	....
1936.....	12.4	23.6	114.2	92.9	104.4	102.5	11.20	33.36	....
1937.....	8.4	20.4	52.9	78.0	51.8	96.2	8.74	19.51	....
1938.....	8.6	19.6	55.7	69.8	48.6	56.2	6.78	21.79	....
1939.....	9.1	15.4	69.7	73.4	56.8	69.1	7.94	21.17	....
1940.....	9.9	16.0	54.1	85.4	61.8	68.2	7.59	21.73	....
1941.....	17.0	26.4	80.8	92.2	75.1	94.4	9.70	47.65	....
1942.....	19.0	36.9	117.0	118.0	91.7	110.0	10.80	45.61	....
1943.....	19.9	40.5	131.0	206.0	112.0	136.0	14.80	52.10	....
1944.....	20.7	42.0	150.0	190.0	109.0	141.0	16.50	52.70	....
1945.....	22.5	36.6	143.0	204.0	127.0	150.0	15.10	51.10	....
1946.....	32.6	38.2	124.0	218.0	156.0	191.0	16.70	72.00	....
1947.....	31.9	38.0	162.0	217.0	216.0	229.0	17.60	85.90	....
1948.....	30.4	48.2	155.0	222.0	129.0	200.0	18.45	67.20	....
1949.....	28.6	46.3	128.0	214.0	119.0	186.0	16.55	43.40	....
November...	27.76	43.4	134.0	189.0	102.0	190.0	16.75	42.30	....
December....	26.50	45.4	131.0	202.0	113.0	193.0	17.15	43.30	....
1950									
January.....	26.47	39.7	136.0	215.0	115.0	192.0	17.15	43.60	....
February....	27.50	34.1	133.0	221.0	116.0	193.0	16.75	43.60	....
March.....	28.05	32.0	132.0	222.0	119.0	198.0	16.45	43.00	....
April.....	28.74	....	134.0	228.0	126.0	201.0	16.65	44.40	....
May.....	29.24	48.5	128.0	228.0	134.0	204.0	17.25	45.20	....
June.....	29.91	49.7	127.0	211.0	136.0	193.0	16.05	46.20	....
July.....	33.05	45.5	127.0	208.0	144.0	199.0	15.15	52.00	....
August.....	36.95	53.1	122.0	218.0	144.0	197.0	15.45	70.90	....
September...	39.98	55.4	105.0	192.0	144.0	194.0	15.55	78.80	....
October.....	38.90	55.1	85.8	154.0	137.0	191.0	15.85	81.50	....

Index Numbers (Aug. 1909—July 1914 = 100)

1925.....	158	168	245	188	109	163	108	140	143
1926.....	101	179	189	134	116	138	112	98	139
1927.....	163	207	146	124	132	135	87	154	127
1928.....	145	200	76	134	131	113	95	152	154
1929.....	135	183	189	133	124	117	92	137	137
1930.....	77	128	131	123	93	76	93	98	129
1931.....	46	82	66	83	50	44	73	40	115
1932.....	52	105	55	62	50	43	52	46	102
1933.....	82	130	118	79	81	84	68	57	91
1934.....	100	213	64	91	127	96	111	146	95
1935.....	90	184	85	80	102	94	63	135	119
1936.....	100	236	164	106	163	116	94	148	104
1937.....	68	204	76	89	81	109	74	87	110
1938.....	69	196	80	79	76	64	57	97	88
1939.....	73	154	100	84	88	78	67	94	91
1940.....	80	160	78	97	96	77	64	96	111
1941.....	137	264	116	105	117	107	82	211	129
1942.....	153	369	168	134	143	124	91	202	163
1943.....	160	405	188	235	174	154	125	231	245
1944.....	167	420	214	216	170	160	139	234	212
1945.....	181	366	205	232	198	170	127	227	207
1946.....	263	382	178	248	212	209	141	319	182
1947.....	257	380	232	248	336	259	148	381	226
1948.....	245	482	222	253	201	226	155	298	214
1949.....	231	463	184	244	210	210	139	192	201
November...	224	434	192	216	159	215	141	188	213
December....	214	454	188	230	176	218	144	192	196
1950									
January.....	213	397	195	245	179	217	144	193	261
February....	222	341	191	252	181	218	141	193	203
March.....	226	320	189	253	185	224	139	191	168
April.....	232	....	192	260	196	227	140	197	205
May.....	236	485	184	260	209	231	145	200	178
June.....	241	497	182	240	212	218	135	205	182
July.....	267	455	182	237	224	225	128	231	200
August.....	298	531	175	248	224	223	130	314	164
September...	322	554	151	219	224	219	131	349	126
October.....	314	551	123	175	213	216	134	361	138

Wholesale Prices of Ammoniates

	Nitrate of soda bulk per unit N	Sulphate of ammonia bulk per unit N	Cottonseed meal S. E. Mills per unit N	Fish scrap, dried 11–12% ammonia, 15% bone phosphate, f.o.b. factory bulk per unit N	Tankage 11% ammonia, 15% bone phosphate, f.o.b. Chicago, bulk, per unit N	High grade ground blood, 16–17% ammonia, Chicago, bulk, per unit N
1910–14	$2.68	$2.85	$3.50	$3.53	$3.37	$3.52
1925	3.11	2.47	5.41	5.34	3.97	4.75
1926	3.06	2.41	4.40	4.95	4.36	4.90
1927	3.01	2.26	5.07	5.87	4.32	5.70
1928	2.67	2.30	7.06	6.63	4.92	6.00
1929	2.57	2.04	5.64	5.00	4.61	5.72
1930	2.47	1.81	4.78	4.96	3.79	4.58
1931	2.34	1.46	3.10	3.95	2.11	2.46
1932	1.87	1.04	2.18	2.18	1.21	1.36
1933	1.52	1.12	2.95	2.86	2.06	2.46
1934	1.52	1.20	4.46	3.15	2.67	3.27
1935	1.47	1.15	4.59	3.10	3.06	3.65
1936	1.53	1.23	4.17	3.42	3.58	4.25
1937	1.63	1.32	4.91	4.66	4.04	4.80
1938	1.69	1.38	3.69	3.76	3.15	3.53
1939	1.69	1.35	4.02	4.41	3.87	3.90
1940	1.69	1.36	4.64	4.36	3.33	3.39
1941	1.69	1.41	5.50	5.32	3.76	4.43
1942	1.74	1.41	6.11	5.77	5.04	6.76
1943	1.75	1.42	6.30	5.77	4.86	6.62
1944	1.75	1.42	7.68	5.77	4.86	6.71
1945	1.75	1.42	7.81	5.77	4.86	6.71
1946	1.97	1.44	11.04	7.38	6.60	9.33
1947	2.50	1.60	12.72	10.66	12.63	10.46
1948	2.86	2.03	12.94	10.59	10.84	9.85
1949	3.15	2.29	10.11	13.18	10.73	10.62
November	3.00	2.32	10.39	14.21	10.39	10.78
December	3.00	2.32	12.94	13.88	9.87	9.94
1950						
January	3.00	2.32	10.27	13.79	10.26	10.08
February	3.00	2.32	9.37	13.45	8.96	8.96
March	3.00	2.32	9.70	13.01	10.17	9.34
April	3.00	2.32	10.34	12.58	10.39	8.19
May	3.00	2.05	10.74	11.97	10.14	7.59
June	3.00	1.71	10.55	10.79	9.41	7.36
July	3.00	1.71	11.53	10.71	9.35	8.74
August	3.00	1.71	11.44	11.06	10.62	9.87
September	3.00	1.71	11.44	10.85	10.85	10.32
October	3.00	1.71	11.86	10.63	10.62	10.32
Index Numbers (1910-14 = 100)						
1925	115	87	155	151	117	135
1926	113	84	126	140	129	139
1927	112	79	145	166	128	162
1928	100	81	202	188	146	170
1929	96	72	161	142	137	162
1930	92	64	137	141	112	130
1931	88	51	89	112	63	70
1932	71	36	62	62	36	39
1933	59	39	84	81	97	71
1934	59	42	127	89	79	93
1935	57	40	131	88	91	104
1936	59	43	119	97	106	131
1937	61	46	140	132	120	122
1938	63	48	105	106	93	100
1939	63	47	115	125	115	111
1940	63	48	133	124	99	96
1941	63	49	157	151	112	126
1942	65	49	175	163	150	192
1943	65	50	180	163	144	189
1944	65	50	219	163	144	191
1945	65	50	223	163	144	191
1946	74	51	315	209	196	265
1947	93	56	363	302	374	297
1948	107	71	370	300	322	280
1949	117	80	289	373	318	302
November	112	81	297	403	308	306
December	112	81	311	393	293	282
1950						
January	112	81	293	391	304	286
February	112	81	268	381	266	255
March	112	81	277	369	302	265
April	112	81	295	356	308	233
May	112	72	307	339	301	216
June	112	60	301	306	279	209
July	112	60	329	303	277	248
August	112	60	327	313	315	280
September	112	60	327	307	322	293
October	112	60	339	301	315	293

Wholesale Prices of Phosphates and Potash * *

	Superphosphate, Baltimore, per unit	Florida land pebble, 68% f.o.b. mines, bulk, per ton	Tennessee phosphate rock, 75% f.o.b. mines, bulk, per ton	Muriate of potash bulk, per unit, c.i.f. Atlantic and Gulf ports[2]	Sulphate of potash in bags, per unit, c.i.f. Atlantic and Gulf ports[2]	Sulphate of potash magnesia, per ton, c.i.f. Atlantic and Gulf ports[2]	Manure salts bulk, per unit, c.i.f. Atlantic and Gulf ports[2]
1910–14	$0.536	$3.61	$4.88	$0.714	$0.953	$24.18	$0.657
1925	.600	2.44	6.16	.584	.860	23.72	.483
1926	.598	3.20	5.57	.596	.854	23.58	.537
1927	.525	3.09	5.50	.646	.924	25.55	.586
1928	.580	3.12	5.50	.669	.957	26.46	.607
1929	.609	3.18	5.50	.672	.962	26.59	.610
1930	.542	3.18	5.50	.681	.973	26.92	.618
1931	.485	3.18	5.50	.681	.973	26.92	.618
1932	.458	3.18	5.50	.681	.963	26.90	.618
1933	.434	3.11	5.50	.662	.864	25.10	.601
1934	.487	3.14	5.67	.486	.751	22.49	.483
1935	.492	3.30	5.69	.415	.684	21.44	.444
1936	.476	1.85	5.50	.464	.708	22.94	.505
1937	.510	1.85	5.50	.508	.757	24.70	.556
1938	.492	1.85	5.50	.523	.774	15.17	.572
1939	.478	1.90	5.50	.521	.751	24.52	.570
1940	.516	1.90	5.50	.517	.730	24.75	.573
1941	.547	1.94	5.64	.522	.780	25.55	.367
1942	.600	2.13	6.29	.522	.810	25.74	.205
1943	.631	2.00	5.93	.522	.786	25.35	.195
1944	.645	2.10	6.10	.522	.777	25.35	.195
1945	.650	2.20	6.23	.522	.777	25.35	.195
1946	.671	2.41	6.50	.508	.769	24.70	.190
1947	.746	3.05	6.60	.432	.706	18.93	.195
1948	.764	4.27	6.60	.397	.681	14.14	.195
1949	.770	3.88	6.22	.397	.703	14.14	.195
November	.770	3.76	5.47	.375	.720	14.50	.200
December	.770	3.76	5.47	.375	.720	14.50	.200
1950							
January	.762	3.76	5.47	.375	.720	14.50	.200
February	.760	3.76	5.47	.375	.720	14.50	.200
March	.760	3.76	5.47	.375	.720	14.50	.200
April	.760	3.76	5.47	.375	.720	14.50	.200
May	.760	3.76	5.47	.375	.720	14.50	.200
June	.760	3.76	5.47	.336	.647	12.77	.176
July	.760	3.76	5.47	.368	.704	13.98	.193
August	.760	3.76	5.47	.368	.704	13.98	.193
September	.760	3.75	5.47	.368	.704	13.98	.193
October	.760	3.73	5.47	.386	.704	13.98	.193
Index Numbers (1910-14 = 100)							
1925	110	68	126	82	90	98	74
1926	112	88	114	83	90	98	82
1927	100	86	113	90	97	106	89
1928	108	86	113	94	100	109	92
1929	114	88	113	94	101	110	93
1930	101	88	113	95	102	111	94
1931	90	88	113	95	102	111	94
1932	85	88	113	95	101	111	94
1933	81	86	113	93	91	104	91
1934	91	87	110	68	79	93	74
1935	92	91	117	58	72	89	68
1936	89	51	113	65	74	95	77
1937	95	51	113	71	79	102	85
1938	92	51	113	73	81	104	87
1939	89	53	113	73	79	101	87
1940	96	53	113	72	77	102	87
1941	102	54	110	73	82	106	87
1942	112	59	129	73	85	106	84
1943	117	55	121	73	82	105	83
1944	120	58	125	73	82	105	83
1945	121	61	128	73	82	105	83
1946	125	67	133	71	81	102	82
1947	139	84	135	70	74	78	83
1948	143	118	135	67	72	58	83
1949	144	108	128	67	74	58	83
November	144	104	112	68	76	60	83
December	144	104	112	68	76	60	83
1950							
January	142	104	112	68	76	60	83
February	142	104	112	68	76	60	83
March	142	104	112	68	76	60	83
April	142	104	112	68	76	60	83
May	142	104	112	68	76	60	83
June	142	104	112	63	68	53	80
July	142	104	112	67	74	58	82
August	142	104	112	67	74	58	82
September	142	104	112	67	74	58	82
October	142	103	112	70	74	58	82

Combined Index Numbers of Prices of Fertilizer Materials, Farm Products and All Commodities

	Farm prices*	Prices paid by farmers for commodities bought*	Wholesale prices of all commodities†	Fertilizer material‡	Chemical ammoniates	Organic ammoniates	Superphosphate	Potash**
1925	156	153	151	112	100	131	109	80
1926	146	150	146	119	94	135	112	86
1927	141	148	139	116	89	150	100	94
1928	149	152	141	121	87	177	108	97
1929	148	150	139	114	79	146	114	97
1930	125	140	126	105	72	131	101	99
1931	87	119	107	83	62	83	90	99
1932	65	102	95	71	46	48	85	99
1933	70	104	96	70	45	71	81	95
1934	90	118	109	72	47	90	91	72
1935	109	123	117	70	45	97	92	63
1936	114	123	118	73	47	107	89	69
1937	122	130	126	81	50	129	95	75
1938	97	122	115	78	52	101	92	77
1939	95	121	112	79	51	119	89	77
1940	100	122	115	80	52	114	96	77
1941	123	130	127	86	56	130	102	77
1942	158	149	144	93	57	161	112	77
1943	192	165	151	94	57	160	117	77
1944	196	174	152	96	57	174	120	76
1945	206	180	154	97	57	175	121	76
1946	234	197	177	107	62	240	125	75
1947	275	231	222	130	74	362	139	72
1948	285	250	241	134	89	314	143	70
1949	249	240	226	137	99	319	144	70
November	237	236	221	136	96	321	144	72
December	233	237	221	136	96	317	144	72
1950								
January	235	238	221	135	96	316	142	72
February	237	237	223	132	96	286	142	72
March	237	239	223	134	96	305	142	72
April	241	240	223	135	96	313	142	72
May	247	244	228	132	91	311	142	72
June	247	245	230	126	85	293	142	66
July	263	247	238	128	85	301	142	70
August	267	248	243	131	85	321	142	70
September	272	252	247	131	85	324	142	70
October	268	253	246	131	85	323	142	73

* U. S. D. A. figures, revised January 1950. Beginning January 1946 farm prices and index numbers of specific farm products revised from a calendar year to a crop-year basis. Truck crops index adjusted to the 1924 level of the all-commodity index.

† Department of Labor index converted to 1910-14 base.

‡ The Index numbers of prices of fertilizer materials are based on original study made by the Department of Agricultural Economics and Farm Management, Cornell University, Ithaca, New York. These indexes are complete since 1897. The series was revised and reweighted as of March 1940 and November 1942.

[1] Beginning July 1949, baled hay prices reduced by $4.75 a ton to be comparable to loose hay prices previously quoted.

[2] All potash salts now quoted F.O.B. mines only: manure salts since June 1941, other carriers since June 1947.

**** The weighted average of prices actually paid for potash is lower than the annual average because since 1926 over 90% of the potash used in agriculture has been contracted for during the discount period. Since 1937, the maximum discount has been 12%. Applied to muriate of potash, a price slightly above $.471 per unit K_2O thus more nearly approximates the annual average than do prices based on arithmetical averages of monthly quotations.**

REVIEWS

This section contains a short review of some of the most practical and important bulletins, and lists all recent publications of the United States Department of Agriculture, the State Experiment Stations, and Canada, relating to Fertilizers, Soils, Crops, and Economics. A file of this department of BETTER CROPS WITH PLANT FOOD would provide a complete index covering all publications from these sources on the particular subjects named.

Fertilizers

"Summary Report of Fertilizer Materials Consumed in Florida for Fiscal Year July 1, 1949, Thru June 30, 1950," Fert. Stat. Div., Bur. of Insp., Tallahassee, Fla.

"Tonnage of Commercial Fertilizer Reported by Manufacturers as Shipped to Kansas in the Spring of 1950, by Counties," Kans. State Brd. of Agr., Control Div., Topeka, Kans., Jan. 1, 1950 to June 30, 1950.

"Analyses of Official Fertilizer Samples Semi-Annual Report, January-June 1950," Agri. Exp. Sta., Univ. of Ky., Lexington, Ky., Bul. 84, Aug. 1950.

"Maryland Inspection and Regulatory Service," Univ. of Md., College Park, Md., Control Series No. 215, (Aug. 1950).

"Commercial Fertilizer Results With Winter Wheat and Rye," Univ. of Nebr., Lincoln, Nebr., Outstate Test. Cir. 10, Aug. 1950, G. W. Lowery, R. A. Olson, A. F. Dreier, and P. L. Ehlers.

"Fertilizer Analyses for July 1, 1948-June 30, 1949," N. C. Dept. of Agr., Raleigh, N. C., Bul. No. 118.

"Fertilizer Possibilities in North Dakota," N. D. Ext. Serv., Cir. A-141, Fargo, N. D., Jan. 1950.

"Suggestions for Fertilizer Use in North Dakota," Ext. Serv., N. D. College of Agr., Fargo, N. D., Cir. A-142, Jan. 1950.

"Fertilizers for Early Cabbage, Tomatoes, Cucumbers and Sweet Corn," Agr. Exp. Sta., Wooster, Ohio, Res. Bul. 697, June 1950, John Bushnell.

"Rotation Fertilization for Pennsylvania," Agron. Extension and Exp. Sta., Pa. State College, State College, Pa., Sept. 1950.

"Fertilizer Recommendations for Virginia," Agr. Ext. Serv., Va. Poly. Institute, Blacksburg, Va., Bul. 183, July 1950.

"Boron, Copper, Manganese, and Zinc Requirement Tests of Tobacco," USDA, Washington, D. C., Tech. Bul. 1009, 1950. W. C. Bacon, W. R. Leighty, and J. F. Bullock.

Soils

"Testing Missouri Soils," Agr. Exp. Sta., Univ. of Mo. College of Agr., Columbia, Mo., Cir. 345, Mar. 1950, E. R. Graham.

"Progress Report, 1950 Soil and Water Conservation Research at the Red Plains Conservation Experiment Station, Guthrie, Okla.," Agr. Exp. Sta., Okla. A & M College, Stillwater, Okla., Mimeo. Cir. M-195, Apr. 1950, H. A. Daniel, H. M. Elwell, and M. B. Cox.

"Progress Report, 1950 Soil and Water Conservation Research at the Wheatland Conservation Experiment Station, Cherokee, Okla.," Agr. Exp. Sta., Okla. A & M College, Stillwater, Okla., Mimeo. Cir. M-196, Apr. 1950, H. A. Daniel, H. M. Elwell, and M. B. Cox.

"Terraces to Control Run-off," Ext. Serv., Univ. of Wis., Madison, Wis., Cir. 386, Mar. 1950, O. R. Zeasman and A. J. Wojta.

"Suitability of Various Soils for Tung Production," USDA, Wash., D. C., Cir. No. 840, July 1950, M. Drosdoff.

"Soil Survey of Union County, Georgia," USDA, Wash., D. C., Series 1938, No. 28, June 1950.

Crops

"Arizona Range Resources, II. Yavapai County," Agr. Exp. Sta., Univ. of Ariz., Tucson, Ariz., Bul. 229, July 1950, R. R. Humphrey.

"Mechanized Production of Cotton," Agr. Exp. Sta., Univ. of Ark., College of Agr., Fayetteville, Ark., Mimeo. Series No. 3, Apr. 1950, K. Engler, W. F. Buchele, and J. C. Newell.

"Progress Report 1934-1948," Div. of Hort., Central Exp. Farm, Ottawa, Ontario, Canada.

"Progress Report 1937-1948," Div. of Forage Plants, Central Exp. Farm, Ottawa, Ontario, Canada.

"Spring Oats for Illinois Variety Trials 1945-1949, Disease Hazards 1949," Agr. Exp. Sta., Univ. of Ill., Urbana, Ill., Cir. 659, Apr. 1950, J. W. Pendleton, W. M. Bever, G. H. Dungan, and O. T. Bonnett.

"Results of Research in 1949," Agr. Exp. Sta., Univ. of Ky., Lexington, Ky., 62 A. R., 1949.

"Effect of Cover Crops and Tile Drainage on Growth and Yield of Peaches," Agr. Exp. Sta., Univ. of Ky., Lexington, Ky., Bul. 547, May 1950, A. J. Olney, S. J. Lowry, and L. M. Caldwell.

"Summary of Results of Experiments at Western Kentucky Substation 1927-1949," Agr. Exp. Sta., Univ. of Ky., Lexington, Ky., P. R. July, 1950.

"Grass Seed Production in Nebraska," Ext. Serv. Univ. of Nebr., College of Agr., Lincoln, Nebr., Ext. Cir. 188, Apr. 1950, L. G. Wolfe and H. H. Wolfe.

"Nebraska Outstate Varietal Tests of Fall-Sown Small Grains 1950, Winter Wheat—Winter Barley—Rye," Agr. Exp. Sta., Univ. of Nebr., Lincoln, Nebr., Outstate Test. Cir. 9, Aug. 1950, A. F. Dreier and P. L. Ehlers.

"Grassland Farming," Univ. of Nebr. Extension Work, Lincoln, Nebr., E. C. 190, 1950, D. L. Gross.

"Birdsfoot Trefoil," N. Y. State College, Cornell Univ., Ithaca, N. Y., Ext. Bul. 797, May 1950, L. H. MacDonald.

"Grow Quality Sweet Potatoes," Agr. Ext. Serv., N. C. State College, Raleigh, N. C., Ext. Cir. 353, Apr. 1950, F. D. Cochran, E. R. Collins, H. M. Covington, H. M. Ellis, H. R. Garriss, G. D. Jones, W. D. Lee, L. W. Nielsen, and P. Ritcher.

"Grass Seed Production," Ext. Ser., College of Agr., Fargo, N. D., Cir. A-139, Jan. 1950, I. T. Dietrich.

"Good Hog Pastures," Ext. Serv., N. D. Agr. College, Fargo, N. D., Cir. No. A-149, Mar. 1950, G. E. Strum and R. B. Widdifield.

"Soybean Variety Tests, 1926 to 1949," Agr. Exp. Sta., Okla. A & M College, Stillwater, Okla., Bul. No. B-356, Aug. 1950, C. L. Canode and J. E. Webster.

"Research for the Farmer," Agr. Exp. Sta., R. I. State College, Kingston, R. I., 62nd A. R., June 1950.

"The Influence of Crop Plants on Those Which Follow V," Agr. Exp. Sta., R. I. State College, Kingston, R. I., Bul. 309, Aug. 1950, T. E. Odland, R. S. Bell, and J. B. Smith.

"Sixty-First Annual Report," Exp. Sta., College of Agr., Clemson, S. C., May 1950.

"Pastures for South Carolina," Agr. Ext. Serv., College of Agr., Clemson, S. C., Bul. 99, Rev. Aug. 1950.

"Fall Tomatoes," Agr. Ext. Serv., College of Agr., Clemson, S. C., Cir. 354, May 1950, R. J. Ferree, A. E. Schilletter, and W. C. Nettles.

"The Vegetable Garden," Agr. Ext. Serv., Univ. of Wis., Madison, Wisc., Cir. 372, Rev. Jan. 1950, O. B. Combs.

"Growing Grapes at Home," Agr. Ext. Serv., Univ. of Wis., College of Agr., Madison, Wis., Sten. Cir. 235, Feb. 1944, Rev. Feb. 1950, J. G. Moore.

"When Pastures and Hay Crops Fail," Ext. Serv., Univ. of Wis., Madison, Wis., Sten. Cir. 310, Apr. 1950, H. L. Ahlgren, G. M. Briggs, and L. F. Graber.

"Barley," Ext. Serv., Univ. of Wis., Madison, Wis., Sten. Cir. 307, Feb. 1950, R. G. Shands and H. L. Shands.

"Preventing Black Rot Losses in Sweetpotatoes," USDA, Wash., D. C., Leaf. No. 280, June 1950, J. S. Cooley and R. J. Haskell.

"The Importance of Pasture and Roughage in the Dairy Program," USDA, Wash., D. C., BDIM-Inf-93, June 1950, R. E. Hodgson.

Economics

"1949 Agricultural Statistics for Arkansas," Agr. Exp. Sta., Univ. of Ark., College of Agr., Fayetteville, Ark., Rpt. Series No. 18, June 1950.

"Farming in Canada," Inf. Serv., Dept. of Agr., Ottawa, Ontario, Canada.

"Handbook of Facts about North Dakota Agriculture," Agr. Exp. Sta., N. D. Agr. College, Fargo, N. D., Bul. 357, June 1950, B. H. Kristjanson and C. J. Heltemes.

"What About Our Large Farms in North Dakota?" Agr. Exp. Sta., N. D. Agr. College, Fargo, N. D., Bul. 360, July 1950, B. H. Kristjanson.

"Keeping Up on the Farm Outlook," Agr. Ext. Serv., Wash. State College, Pullman, Wash., Ext. Cir. No. 161, Aug. 31, 1950, K. Hobson.

"Cotton Production in the United States, Crop of 1949," Supt. of Documents, U. S. Govt. Printing Office, Wash., D. C.

"1951 Agricultural Conservation Program National Bulletin," USDA, Prod. & Mktg. Adm., Wash., D. C., 1061 (51)-1, September 1950. (Reprinted from Federal Register of Sept. 12, 1950.)

The Good Old Days

Grandmother, on a winter's day, milked the cows and fed them hay, slopped the hogs, saddled the mule, and got the children off to school; did a washing, mopped the floors, washed the windows, and did some chores; cooked a dish of home-dried fruit, pressed her husband's Sunday suit, swept the parlor, made the bed, baked a dozen loaves of bread, split some firewood, and lugged in enough to fill the kitchen bin; cleaned the lamps and put in oil, stewed some apples she thought would spoil; churned the butter, baked a cake, then exclaimed, "For heaven's sake, the calves have got out of the pen"—went out and chased them in again; gathered the eggs and locked the stable, back to the house and set the table, cooked a supper that was delicious, and afterward washed up all the dishes; fed the cat and sprinkled the clothes, mended a basketful of hose; then opened the organ and began to play, "When you come to the end of a perfect day."—Kalends.

Insect Control Goes With Fertilizer Plan

(*From page* 23)

twice before the square formed. He did not dust again until the bollworms hit; however, it was not followed through in its entirety since the tractor harmed his crop of grown bolls. It appeared that the dust he put on did more harm than good, since the excessive late July rains assured excellent weather for the bollworm. Actually, the build-up of beneficial insects helped more than poison in controlling these worms, especially since the weather prevented five-day intervals of dusting. Cleveland reported positive evidence of beneficial insect build-up.

His neighbor, Richard Redus, who was runner-up to Clark in the State contest with 613.8 pounds of lint per acre, followed the same pre-square dusting schedule but used a different amount and grade of fertilizer. He used 300 pounds of 8-8-8 per acre on land following cotton. Last year he made 3¾ bales of cotton on 23 acres. He did not follow the complete fertilizer, dusting program as that in 1949 on the five-acre demonstration. He made 23 bales on 28 acres in 1949, dusted it all pre-square, but did not use fertilizer on all of this cotton.

These two demonstrations and all the others except one were on soils normally considered marginal cotton-producing soils of the County. They are light-textured soils overlying a dense claypan and tend to be droughty. They are inherently low in fertility and require annual applications of fertilizers to make any kind of profitable crop. Normally these soils are considered potash-deficient and cotton develops what is locally called "greyland rust." The leaves scorch along the outer edges and finally fall off along about maturity time. This prevents the bolls from filling out and causes a reduction in yield and grade.

The 8-8-8 and 4-8-8 fertilizers are becoming increasingly popular with these farmers as a fertilizer that helps relieve this "rust" situation. Soil tests have shown that this shortage exists and as a result more and more farmers are going to these grades high in potash. Many acres that have never before received any applications of fertilizer will be fertilized next year. These twelve farmer demonstrators have shown that insect control is a must in achieving maximum yields with these fertilizers.

Tall Fescue in the Southeast

(*From page* 11)

solute essentials. In a great many cases, legumes have starved out of the mixture, and fescue has been said to have crowded the legumes out. Tall fescue and reseeding crimson clover were seeded together on poor, cherty upland near Dalton, Ga., in the fall of 1947. In checking the volunteer stand of clover in December of 1949, it was observed to be patchy. A natural assumption was that the fescue was crowding the clover out, but on closer examination it was found that the thick patches of clover were where the fescue was most vigorous. This indicated that the greater fertility in these patches was an important factor in keeping the clover in the mixture.

Grazing has appeared to be an important factor in maintaining a balance between fescue and ladino or other legumes. At seasons when either plant tended to dominate, grazing appeared to reduce competition and helped to

keep the sod in balance. Examples have been observed where annual lespedeza in mixtures with fescue was not grazed during the summer. The lespedeza grew so vigorously that it overtopped the fescue in mid-summer and reduced the vigor of the grass stand. In a few cases, grass stands were severely thinned by this competition.

Fescue has been seeded on a good many old stands of sericea and this mixture has looked promising on uplands where shallow-rooted plants usually are severely damaged by summer drought. This mixture appears to be best adapted under pasture conditions where both plants are grazed down so that neither can dominate. Sometimes sericea has been mowed for hay in the summer and the fescue pastured during the winter. Where sericea was left uncut and ungrazed during the entire summer and harvested for seed in the fall, fescue stands were severely thinned during the latter half of the summer. Likewise, where fescue was fertilized heavily with nitrogen in the spring and left for a seed crop, the very heavy grass turf has weakened the stand of sericea.

Other Mixtures

Wild winter peas (also called Caley or Singletary peas), sweet clover, and several other legumes have shown promise in mixtures with fescue. A principle that has become more evident as we have gained further experience with this new grass has been that legumes to be grown with fescue must be selected on a basis of their adaptation to the soil. In one part of a state, or even a county, soils may be of limestone origin and well-adapted to ladino clover. In another part of the county, soils may be derived from sandstone and either annual or sericea lespedeza may be the best legume for use with fescue.

It is doubtful whether anyone can tell how long a stand of tall fescue is going to last on a particular soil. The very old sod that has been on the Suiter farm in the mountains of eastern Kentucky for 50 or more years would lead to the assumption that a fescue sod may last almost indefinitely. Under different soil and grazing conditions, a sod may be much less permanent. All that we have seen to date indicates that a sod will last a good many years if fescue is grown with an adapted legume and the soil is treated adequately to maintain the legume in vigorous condition. The rate of grazing also appears to be quite important. A few cases have been observed where good stands of fescue on well-adapted soils were grazed so closely that almost every plant was killed.

Disease Injury

Disease may be a more serious problem in the Lower South than it has been in Kentucky and other parts of the Upper South. A recent report from Louisiana of severe damage to fescue by helminthosporium is the first time very serious disease injury has been reported. Most of the leaf diseases that have been observed appeared to be much less severe on good land where fescue was well supplied with nitrogen than on poor land where the grass was starved for nitrogen. L. L. Patten of Lakeland, Ga., has noted that fescue he planted following a manure crop such as crotalaria or hairy indigo was more vigorous and less affected by helminthosporium and other diseases than it was on similar land where the manure crop did not precede the fescue.

Our experience to date has led to the opinion that fescue for winter pasture must be protected from grazing from late summer until winter grazing is to begin. Fescue remains green enough during cold weather to be eaten readily by livestock, but it makes almost no growth when the temperature is below about 65 degrees. If stock are removed in late summer, grass in a mixture with a good stand of clover, or with an application of nitrogen fertilizer, should have 8-10 inches of leafy growth by the time cold weather begins. Sample areas in a field of fescue

and Louisiana white clover were harvested for yield in west Tennessee in the late fall of 1948. The yield in terms of cured hay was a little more than 1½ tons per acre.

We need more information about the use of nitrogen fertilizer where fescue is grown in mixtures with legumes. The white clovers and other legumes supply enough nitrogen to keep the fescue green, but not enough for maximum growth. Further experience must be gained before we can tell whether applications of nitrogen will stimulate the grass to such vigorous growth that the legumes will suffer more severe competition.

Those of us who have had an opportunity to study tall fescue in Soil Conservation Service nurseries and on hundreds of farms believe it is a good grass. Farmers likewise believe it is a good grass. They have shown this by expanding their acreage as rapidly as seed was available. Many of them started with five acres or less for observation and have increased their plantings to several hundred acres. Tall fescue is not a "wonder grass" that is going to replace all others. It promises to be very useful in the land-use phase of soil and water conservation planning. It will do several conservation jobs on both grazing land and cropland. We have not had well-adapted, perennial grasses to do these jobs in most parts of the Southeast. Several other kinds of pasture will be needed, in addition to fescue, before we reach the desired goal of year-round green pastures. It is our hope that this progress report may be helpful to others who are studying the tall fescues.

Tree Symptoms and Leaf Analysis

(*From page* 22)

been effected in two years, although there are still plenty of potassium-deficiency symptoms apparent. However, foliage color and new growth were greatly improved and most of the crop sized up uniformly to No. 1 fruit. Analysis on a comparable leaf sample now shows: Potassium in the leaves—0.43%.

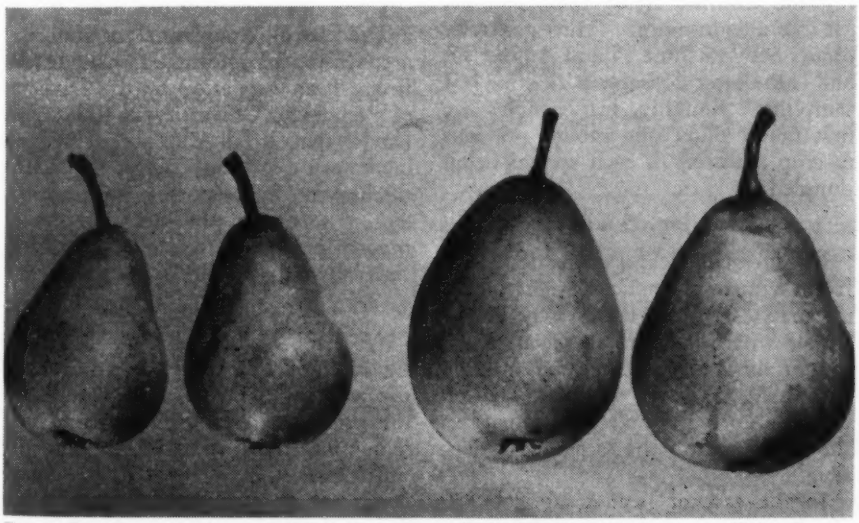


Fig. 6. Pear fruits showing typical size comparison. (Left) Potash-deficient trees. (Right) Potash-treated trees—Agnew, California, area.

While this does not show a large figure for potassium, it is still a 200% increase and in our experience with other kinds of trees, notably almonds, this much of an increase is enough to effect a great improvement. Although we have not had as much experience with the pear as with other fruits, we feel that potassium optimum may be at a lower level than for the prune, probably .75 to 1% K in leaves collected late in July.

Where potassium is deficient, a massive application will be sufficient for at least five years. This brings the cost per annum down to that of most fertilizer applications and lower than some.

The amount of each element which might be found in a leaf will vary during different portions of the growing season. For this reason, samples for accurate comparison must be collected at approximately the same time each year.

The percentage of potassium, phosphorus, and nitrogen increases to a point of time in relation to crop maturity and then decreases with the age of the leaf. Calcium, magnesium, sodium, and chlorine increase with the age of the leaf. There is a period during the summer when these changes are at a minimum. This generally occurs between June 15 and August 15, and is the most desirable period for leaf sampling. Roughly, leaf samples are best taken about one month previous to crop maturity of each species being sampled.

Sampling of Leaves

In general 100 leaves of the deciduous fruits will supply sufficient material for all analyses. More leaves may be desirable where they are small, as in the case of almonds. It should be carefully noted that the leaves which are selected to make up the sample for comparison should be as near the same age as possible.

In the case of prunes, apricots, almonds, apples, and pears, the leaves should be collected only from the spurs. Peach and nectarine leaf samples should be collected from the basal portion of the current season's growth.

The number of trees to be sampled will depend on the nature of the study and the number of trees involved.

Where a study of potassium is of primary interest, a sample made up of 10 spur leaves from 10 trees affected, or a sample of 20 leaves from 5 trees should be taken. A sample of 100 scorched leaves from one or more trees is advisable. It is most important that a sample from known good trees be taken to serve as a check. All leaves should be of the same age and taken from the same location throughout the sampling.

Growing Demand

There is a growing demand for leaf-analysis service by commercial laboratories to be run for a nominal fee. This is as it should be, and as a result, there are a number of laboratories making chemical leaf analyses in California.

Any leaf tests, however, that do not conform to proper timing and uniform selection of leaves and uniform laboratory procedure will be of little value to growers for comparison in determining their trees' need for supplemental potassium.

Unless leaf-sampling practice is standardized by all commercial laboratories, a confusion of information will result. It has been suggested by the Division of Pomology, University of California, Davis, that if all commercial testing laboratories would adopt standard methods of analysis and a uniform system of reporting, the interpretation of reports of analyses would be greatly clarified and simplified.

Exploratory Work

As far back as February 1946, the Division of Pomology had completed the analyses of 23,000 leaf samples in the process of establishing critical leaf values which can be associated with the nutritional status of fruit trees. These levels are now used as a comparative reference in the interpretation of current leaf analyses, which emphasizes all

the more the importance of uniform sampling and reporting methods.

"Formally we supplemented our soil analyses with leaf analyses; today, we supplement our leaf analyses with soil analyses," according to Dr. Lilleland. He continued by saying, "Both are necessary for a complete understanding of nutritional problems, but leaf analyses together with tree symptoms are today the best criteria for studying nutritional problems in deciduous orchards in California."

Corn Is a Superior Crop

(*From page* 13)

cated in extreme southern Illinois in the rolling Ozarks Hill region. The general soil classification is yellow hill land. No limestone or additional organic matter was added to the land. The good corn yield on this land in 1949 might be in part attributed to favorable rains at just the right time during the growing season.

TABLE III.—PROPORTIONS OF GRAIN, STALKS, COBS, AND GRAIN YIELD AT THE DIXON SPRINGS STATION 1949.

Fertilizer	Part of crop	%	Grain bu/A
0–20–20 200 lbs....	Grain	34.9	26
	Stalks	57.8	
	Cobs	7.3	
0–20–20 200 lbs... 8–8–8 200 lbs..... Cyanamide 837 lbs.	Grain	51.4	85
	Stalks	39.1	
	Cobs	9.5	

0–20–20 plowed under
Cyanamide, plowed under
8–8–8 put on at planting time.

On the Dixon experiment field in northern Illinois the corn grain made up 51.6% of the crop in 1948 with an acre yield of 109 bushels. On this field the soil organic matter had been replenished by nearly 40 years of crop rotation, residues added along with limestone, rock phosphate, and muriate of potash (RLrPK). To this land were added 400 pounds of ammonium sulphate and here the percentage of grain was 49.2% and the acre yield went up a few bushels to 115. This additional nitrogen under these conditions gave only a slight decline in the percentage grain and a corresponding small increase in the percentage of stalks and cobs. This soil on the Dixon field is mainly Muscatine silt loam, one of the best corn soils in Illinois. (Table IV).

TABLE IV—PROPORTION OF GRAIN, STALKS, COBS AND GRAIN YIELD ON THE DIXON EXPERIMENT FIELD 1948.

Soil treatment	Part of crop	%	Grain bu/A
RLrPK.....	Grain	51.6	109
	Stalks	39.7	
	Cobs	8.7	
RLrPK..... Ammonium Sulphate 400 lbs.....	Grain	49.2	115
	Stalks	41.7	
	Cobs	9.1	

R—crop residues, L—limestone, rP—rock phosphate, K—muriate of potash.

Where everything is considered, American hybrid corn represents a remarkable agricultural development. The object of the crop is to produce grain with the minimum of stalk and cob growth. This it does very effectively. Apparently corn is adapted to variations in soil conditions better than other Midwest crops and grain production is not thrown out of balance by an oversupply of fertility.

The Minor Element Problem

(*From page* 18)

considerable value as sources of minor elements, since the sea contains traces of all the elements. In this connection, it would seem desirable that more study be given to the possibility of substituting sea salt for the highly refined product now in common use.

Within recent years a great deal of publicity has been given to organic farming as distinct from the type in which use is made of chemical fertilizers. In such a system, dependence is placed on manures and composts. In proportion as these organic materials can be accumulated and used, the available supply of minor elements in soils can be maintained at higher levels than would be possible without specific additions of salts of these elements to the soil. This is especially true in connection with the use of garden composts and sewage sludges that contain residues of plant products from all over the earth. The refuse of Brazilian coffee, Yucatan bananas, Florida oranges, Rio Grande Valley grapefruit, California carrots, home-state crops, and home-garden produce all meet in the backyard compost pile. Sewage sludges contain minor elements in the form of medicinals and by-products of chemical industries, sometimes in concentrations so high as to be injurious to plants growing on the soil to which they are applied.

Lengthened Life Span

It would seem that the people of the United States of America are not in dire need of minor elements, since our life-expectancy at birth is now over 65 years. Yet if all man's nutritional and other needs were met, his span of life might well be more than a century. Certainly a great many of the ills of man can be traced to food deficiencies of one sort or another. This no doubt could be remedied by giving more attention to balance and variety in the diet. In the absence of this, supplemental use of both the major and minor mineral elements has helped in many cases.

Most agricultural experiment stations now have one or more research projects that involve minor elements. In our soils department at New Jersey, seven of our graduate students are devoting themselves entirely to iodine, manganese, zinc, copper, molybdenum, cobalt, and nickel, respectively. Use is being made of radioactive forms of five elements. Similarly the several bureaus of the U. S. Department of Agriculture are concerned with this problem. The U. S. Plant, Soil, and Nutrition Laboratory at Ithaca, New York, is engaged primarily in the study of minor elements in relation to plant and animal nutrition. Johns Hopkins University recently received a grant of $500,000 for this purpose. A number of commercial laboratories are being financed by industry in the study of minor elements. Producers of pharmaceuticals are carrying on studies of these elements as constituents of medicines and the same applies to the manufacturers of feeds.

It is apparent that a great many people are concerned with one or another phase of the minor-element problem. The most complete picture of the undertakings in this field of research is contained in a 1087-page volume entitled "Bibliography of the Literature on Minor Elements and Their Relation to Plant and Animal Nutrition, Fourth Edition," published by the Chilean Nitrate Educational Bureau in 1948. That volume contains abstracts from some 10,000 papers covering 45 elements that had been published as of that date.

Spectographic Laboratory

Recently there has been widespread discussion about having a large central spectographic laboratory, operating on a mass-production basis, to which

anyone who desired could send samples of soils, plants, and animal parts for analysis as to their minor-element content. There are many very attractive features in this. Among these might well be listed the rapidity with which the analyses could be made, the accuracy that should go with the best of equipment and with much practice, and the relatively small cost per analysis on such a large scale.

It would seem that anyone who wants such analyses made should have access to such a laboratory. It is conceivable that many educated farmers would like more definite information about their soils and crops than their agricultural experiment station can provide for them. A considerable number of research workers themselves would make use of such a service.

But there are several weaknesses in this procedure. The problems involved in choosing dependable samples are so great that even the best research men are troubled by it. Spectrographic analyses of soils for minor elements are very difficult because of the mass of other mineral constituents in them, and they provide no clue as to the availability of the supplies found. Interpretation of minor-element data is often very difficult because of the dearth of factual information concerning the quantities of minor elements required by plants and animals.

For satisfactory results from such an enterprise, it would be necessary to have a highly capable director in charge. He would need some well-qualified assistants to keep in touch with research laboratories dealing with minor elements and to follow up all abnormal results to the end that dependable clues were developed. At best, however, such a laboratory would be of value only as a supplement to the vast amount of research required to determine the functions of these elements and the quantities required for normal growth and health of plants and animals.

Farming With Green Manures

(*From page* 26)

as large as the first which then may be plowed in and corn, buckwheat, or some other crop may be seeded to be turned under for a fall crop such as wheat.

The suggestion of Mr. Harlan's that the rye be cut and let lie where it falls hints at his method of handling green manures. Perhaps a combination mulch and green manure would describe his method more clearly as he favors cutting a crop when in blossom, letting it lie where it falls, then a second crop will grow up through it to make additional green matter when the whole mass may be turned under or disked. This method of cutting the crop when in blossom and letting it lie he calls "surface mulching" and gives many reasons to support such a practice.

In the first place, he writes, when green crops are raised to improve the land it is not indispensable that they should be plowed in to accomplish this object. The quickest way to convert the green crop into money is to cut it down while in blossom and let the rains leach out the albuminoids and soluble materials. While the ground is thus shaded and while decomposition is going on, a second crop will spring up and add additional material. He also warns farmers not to waste time by mixing green manures deeply with the soil as combustion is the rapid condition of decay, and when green or other material is buried in the soil it may exclude oxygen and thus combustion may stop or be slowed up materially. A piece of soil heavily shaded, he continues, by surface manuring actually decomposes like a manure heap; that is, it undergoes a sort of putrefaction or chemical change which sets free

its chemical constituents, unlocks, as it were, its locked-up manurial treasures, and fits its natural elements to become the food of plants. Another advantage of cutting a crop and letting it lie is that it will check every weed that "might be concealed among it."

It was a very common practice among agricultural writers in those olden days to advise all persons having large farms in poor condition to sell one-half or two-thirds of their land and apply all of the money they received in manuring and improving the balance of their property. Mr. Harlan disagrees as he says that the poor land would bring no price and that a better way would be to seed the whole farm to clover, cut it when in blossom, and repeat this practice for several years until the land was improved, or better still to select a few acres and make those acres rich and productive first and then select a few more acres and do the same thing.

If you have a field of 20 acres, and Mr. Harlan likes to use this size field for his illustrations, select 5 acres to be improved. First, seed entire acreage to clover—next, cut clover on the 20 acres when in blossom and rake it onto the chosen 5 acres. The remaining 15 acres will have a second crop of not less than 10 tons per acre which should be cut and also raked onto the same 5 acres. This second cutting should be made about the first of August when the whole field should be given an application of fertilizer (plaster) and you will have at least 5 tons per acre by the middle of September which should also be cut and raked onto the same 5 acres. These three dressings of clover will make altogether 525 tons of green manure concentrated on the 5 acres.

Costs Involved

Now as to costs, assuming that it will cost $1.50 per acre to cut and spread the clover, the total cost will be $30 for the 20 acres for the first cutting. The remaining 15 acres cut twice would bring the total to $75 and then adding the interest on the land $120 to that would make a grand total of $195. Some of these costs would seem very low based on present wages but these are Mr. Harlan's figures. Let us compare this rich deposit of plant food, he continues, with purchased stable manure at only $3 per ton for the manure and for the labor of spreading it on the land. The 525 tons of green clover contain 6,300 pounds of nitrogen, 1,312½ pounds of phosphoric acid, and 4,725 pounds of potash, which is about twice as much nitrogen and about the same amounts of phosphoric acid and potash as in 375 tons of stable manure. The 375 tons of stable manure would cost $1,125 for the 5 acres as compared with the cost of the clover, leaving a balance in favor of the clover of $930 which is a significant difference even to the statistical experts.

In improving the land with buckwheat, he advocates somewhat the same method except that he would seed the entire 20 acres to buckwheat and rye as soon as any grain crop is off in July. He would let these two crops remain on the land during the winter as one crop will act as a mulch for the other and both together will protect and improve the soil. By the middle of May the rye will be in blossom and should be carefully cut down. Then a second crop will spring up and in 6 to 8 weeks may be as large as the first. Plow all together and by the first of August put in corn as a mulch for wheat. Thus we have four green crops and wheat.

Favoring Surface Mulch

Summarizing the points brought out by Mr. Harlan in favor of surface mulching we find that by leaving the mulch on the ground the soil will lose nothing by evaporation and one rain in May will ensure the crop against drought: green manures by their ability to collect and preserve moisture on the surface render an immense assistance in the growth of the organic world; surface mulching shades the ground; the rains leach out the albuminoids and soluble solids and they are carried into the soil; the land is more easily worked, that is,

it is easier to plow or disk; weeds will be checked and the soil will be vastly improved.

Mr. Harlan stresses firming the seedbed and offers many examples confirming the benefits to be derived from rolling or in some way firming the seedbed. He relates one instance which occurred during the Civil War when a Northern army of 18,000 men encamped on a Southern field of growing wheat. When they left there was hardly a blade of wheat showing and the ground was packed so solidly that it resembled a public road. Yet when spring came, the wheat came forth with vigor and produced such a crop that the good people in the neighborhood declared that Providence had taken special care of it because it had been trodden down by unrighteous feet.

Another interesting illustration he cites had to do with a retired sea captain who tried to grow some tobacco for "home consumption." Right after he had sown the seed, a gang of youngsters held a dance on the field one night. They not only danced all over the field but they tramped and tramped so that the ground was packed as hard as a surfaced road. What the captain said the next morning when he saw what the kids had done is not stated, but to his astonishment every seed seemed to sprout and grow and he had a fine crop. Every year thereafter the old sea dog tramped the field himself.

Manure Expensive

For a farmer to keep livestock for the manure is mighty poor business according to Mr. Harlan and he minces no words in condemning the practice. He is helped out by that Model Farmer of England, Alderman Mechi, who says that "if stock is too dear or you are short of capital, plow in green and root crops." However, Mr. Harlan advises the careful handling and applying of manure if one does have livestock and he says that it should be applied on the surface of the ground and not plowed under. If one does keep livestock, Mr. Harlan advises the soiling system rather than pastures and in that he is in accord with Horace Greeley who condemned pastures to the nth degree. Green plants can be converted into plant food without undergoing the process of digestion in the stomachs of cattle. Neither is the conversion of vegetable matter into manure necessary.

One year for many miles around Wilmington the pasture fields were brown and bare. The grass was nearly dead due to a lack of rain as no "deep wetting rain" had occurred for two months. Yet the corn that had been sown for soiling still showed signs of growth and, although its growth might have been shortened, there was still plenty of fodder. Sudan grass sown also for soiling was in fair to good condition.

In regard to soiling versus pasture Mr. Harlan says that with green crops and no grazing one does not need fences and in his opinion fences are an abomination. In the Yearbook of Agriculture, he does not say what year, a Mr. Wells writes, "The amount of capital employed in the construction and repair of fences in the United States would be deemed fabulous were not the estimates founded on statistical facts which admit of no dispute." Burknap, a writer on farming topics, says, "You will scarcely believe me when I say that the fences of this country cost more than 20 times the amount of specie that is in them."

Proper Diet

Included in this book on Green Manures are chapters on a proper diet for humans, a discussion on the necessity of preserving bird life to control the insects, and a chapter on orchards. Harlan advises that fruit trees of every kind should be set in a rich field well set with clover, and in June the clover should be cut and spread around the trees as a mulch. Leave a space around each tree so as to prevent the mice from establishing a nest. This mulch should last for three or four years and during this time the clover should be cut and let lie where it falls.

In discussing proper eating, a subject which he says he has been studying for 40 years, Harlan is very definite that people eat too much bread in proportion to other foods. The proportion of minerals and carbohydrates should be carefully observed. Too much bread causes many ills as it introduces too much carbon and hydrogen into the blood; so bread, butter, lard, sugar, and fat must bear a wise proportion to the lean meats and to the fruits and vegetables one eats.

Very little mention is made by Mr. Harlan regarding fertilizers in his book, but his favorite fertilizer seems to be plaster. He quotes Mr. Lawes in that "potash is generally found in sufficient quantity in the soils and the artificial supply is not required," but he is not in agreement with this statement. He, Mr. Harlan, advises us to use all the wood ashes we can procure at a reasonable price, particularly on sandy land, for potash is greatly needed on that kind of soil. He brings out the point that when a farmer employs green manures and also applies fertilizer that the increased crop, which could have been secured with green manures without any fertilizer, would be credited to someone's "nitrogenized superphosphate of lime" or some other fertilizer.

A rather unique method of estimating the cost of green manure is employed by Mr. Harlan in that he says in computing the cost of raising green crops for manure we must not deduct the cost of plowing and harrowing from the value of the green dressing because tillage is a manure and often the very best manure we can apply to many fields especially to heavy clays. Mechi also agrees that "frequent tillage is our best and cheapest manure."

Perhaps a concluding statement could be this: After a farmer has learned the advantages to be derived from green manures, Mr. Harlan says, "With this knowledge accepted as a great truth the careful farmer will always employ a trustworthy collector of Nature's manurial treasures and among these he will find by long experience that red clover stands in the highest rank."

Hope and Promise

(*From page* 5)

traditions and customs, prejudice and poverty. Technical assistance may mean a hand hoe and a good shovel and a disinfecting crew rather than a course in tractor operation or a seminar in economics. That is, we can be too strict in the way we interpret this assistance, and allow the technique to outrun the practice. We can easily load up with more "professors" than we have progressors getting their benefit. Beware of letting American enthusiasm run too loose with panaceas! Especially if we operate in a foreign land.

But here we must halt by the roadside and remember that up ahead there may be some nasty doings with guns and bazookas. All this planning for technical aid to raise human-living hopes is mainly set up to work in peaceful times. I should perhaps say "relatively" peaceful times. What about the outlook for all these brave programs if the world plunges back into the abyss of war? What will FAO do then?

If the conflict were bad and widespread and the struggle should be prolonged, then many nations now paying part of the cost of FAO might be obliged to use all their resources for defense, or become impotent to contribute because of being conquered and overrun. I really have some doubt that FAO would be fully endorsed by our own munificent Congress in case of outright global engagement.

Another alternative is that FAO might get enough money from us and a few of the old stand-bys to hobble along with a skeleton staff, including

the janitor, the messenger to ECA and USDA, and the director-general and the bulletin editor. But nobody in FAO could do much research or visit the underprivileged or plan for tomorrow. All the work done hitherto would get moldy and a new start might be hard to make in your day or mine.

NOW there is still one more possibility to consider in wartime. The war-torn world would need to establish food pools and resources, set up priorities, keep food moving where needed, prevent waste, and, in short, perform a job like that of the International Emergency Food Council. The brasshats might direct things, but the spade work would have to be handled by food experts. Maybe this is where FAO fits into the war picture.

Postwar desolation and hunger would be so great that some big and capable organization would be necessary. Whether that duty would devolve upon FAO is purely conjectural.

Returning to the field of present facts, it strikes me that when we spend so much funds and time on overseas propaganda in behalf of the democratic way of life and the advantages of existence in a land of plenty—and of waste—we may be sadly overlooking a basic point where FAO and its allies might afford a goodwill demonstration. We point with vocal pride in these overseas broadcasts to our superlative possessions and happy families and full larders. Now it would seem likely that when those who don't have a fractional part of such advantages listen in on such speeches they could become bitter and envious. Envy breeds hate.

What are we doing, on the other hand, to prove that there is a way for the ones who do not have these things to get them—good food, enough clothing and shelter, and a little hope? Time was when foreigners without a decent chance to improve their lot could pack up and sail over here to get that chance. Those immigrants who came here established themselves firmly and some of them are our own ancestors. But the doors are no longer open so wide for the beaten and discouraged foreigners, even though the metal tablet on the statue of liberty says so. Yet they are closer to us in terms of distance and time than ever and are therefore part of our community. Unless they get help and gradually lift themselves out of chaos and fear, we are not going to dwell safely in this snug little corner alone.

So we have to do things differently. We have to show them how it may be possible to develop skill and resourcefulness on their own hook, using some of the methods we have used—technical, mechanical, maybe political. To set up these information agencies now is not going to be so hard as though we had no international setups with which to reach out and get to these people on their own terms and with their own language.

I BELIEVE that the Voice of America and such overseas efforts might do themselves proud and be a lot more effective if they tried to tell these bewildered folks that Uncle Sam is endorsing FAO and all it stands for—short of that trade scheme we mentioned; and that this nation wants to see a square deal and more productive power in the small, impoverished, and backward lands. It would not be enough just to say that we believe in these things that make for better human dignity and hope. It must be followed up with action. Maybe not just appropriating a lot more billions, but in making a few millions already provided go further and faster and more effectively than they do now.

It's always so easy here to think that when the money is provided by Congress then the average citizen need do nothing until the scheme falls through or peters out—and then it's his cue to holler and throw dead cats around. We are great beginners, but we often fail on the follow-up.

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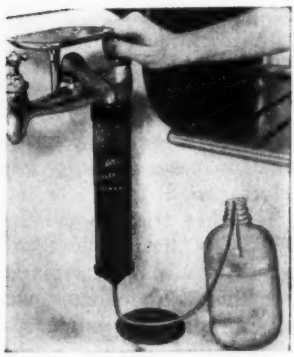

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smoothed away. Many folks here, as well as in the member nations of the UN organization, wish to see improvements carried out by separate nations themselves instead of by concerted international machinery. The hard and soft currency divisions make realistic reform more tedious to negotiate and bring to pass. There are also diverse opinions between countries who are really contributing financially to the picture and others who merely get the grants and benefit by them.

Fortunately, the stronger position of the United Nations since the Korean tide has turned things more toward eventual peace has helped the position of FAO in many respects. It has not settled its budget vexations or decided the location of the official headquarters entirely, but these matters will probably be worked out fairly well after the November meeting of the delegates in Washington.

Whatever opinion we retain as to the future of FAO and whatever plans we discuss pro and con about succor for the weak and weary, at least we know that a closer unity and a better "big-team hitch" has been arranged than we ever had before in world affairs.

FAO has sent a doughty, resolute, elderly, bronze-faced Oregon ranchman into the far corners of the universe to look into the weazened face of want and step across the ditches of despair and ignorance. He has had first-hand contact with the sufferings and the maladjustments due to war, neglect, greed, indifference, and cruelty. This prophet of FAO has no secret aims to promote and no ruthless aggression to foster. He is an example of a thoughtful, practical idealist, such as we breed in large numbers in America—contrary to the Moscow theme. He has both firm feet on the ground. Although over three score and ten, he is vigorous and alert. He can sit out as many "conferences" as the younger chaps and come forth jaunty and ready for more argument.

Some of his friends of the old days

refer to this leader of the FAO as "Almighty Dodd." Some of the followers of ancient leaders looked to their prophets and elders as one would toward a representative of the Divine plan. If work for the best interests of mankind and the real needs of our times is any criterion, then leaders of such single and devoted purpose do really stand for something beyond the routine affairs of life. If they are tough, hard-bitten, rocklike men who know the false from the workable and can sift the chaff out of all the grist and keep the kernels—we feel safer about the movements in their trust.

If FAO should change leaders and elect some unknown and untried personality, it might be a temporary setback. But the movement itself needs to be made so practical and effectual that the absence of any one element of its spiritual force or personal leadership need not cut its power for good. The only way we can see to that is to mix into the business ourselves. If we just leave it all to a few economists and travelers and experts who hover around Washington or Paris or Hong Kong, and do not come to adopt the FAO as a vital leg of our farm progress, it may fritter away and never be replaced.

Fortunately, the major American and most of the foreign agricultural societies in the western nations have put themselves behind the aims and purposes of FAO. This makes it easier for ordinary individual farmers to join in and take some part, however humble. This is not a short, temporary attack on the enemy. It is a long grind of persistent activity. It will take patience and wise counsel and careful avoidance of pitfalls and blunders. It is not a hullabaloo of noise and fireworks, but a steady sweep of silent but hopeful power.

Let's change the meaning of FAO to spell "forward against obstacles." If it falters and dies, the farmers of Iowa, Kansas, and all the rest of rural America will have lost as much as those who have never used a tractor or filled a silo or ridden in a brand new car.

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Department of Visual Education, University of California Extension, 405 Hilgard Ave., Los Angeles 24, California.
Department of Visual Instruction, Oregon State College, Corvallis, Oregon.
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Canada: National Film Board, Ottawa, Ontario, Canada.

IMPORTANT

Request should be made *well in advance* and should include information as to group before which the film is to be shown, date of exhibition (alternative dates if possible), and period of loan.

Request bookings from your nearest distributor

A pessimist is a man who wears a belt and suspenders at the same time.

* * *

A sensible girl is not as sensible as she looks because a sensible girl has more sense than to look sensible.

* * *

"And what are your grounds for divorce?"

"Joe snores, Your Honor."

"How long have you been married?"

"A week."

"Divorce granted; you shouldn't know whether he snores or not."

* * *

Two negroes were talking about a recent funeral where there had been a profusion of floral tributes.

Said one: "When I die I don't want no flowers on my grave. Jes' plant a good old watermelon vine; and when she get ripe you come dar, and don't eat it, but jas' bust it on de grave, and let de good old juice dribble down through the ground."

* * *

Collector—"Will you give something to the Old Ladies' Home?"

Citizen—"With pleasure — I'll send my mother-in-law right over."

* * *

A little boy boarded the streetcar wearing long pants. The conductor charged him full fare. At the next stop a little boy boarded the streetcar wearing short pants—half fare. Next stop, a young lady entered the streetcar and the conductor collected no fare.

No! No! She had a transfer.

We leave a good party reluctantly and get up the next morning even more reluctantly, wondering what there was about the party that made us so reluctant to leave.—Bagology

* * *

Blonde: "Sorry, soldier, but I never go out with perfect strangers."

Soldier: "Don't worry about that, babe, I ain't perfect."

* * *

A man was driving in the country one day, and he saw an old man sitting on a fence rail watching the automobiles go by. Stopping to pass the time of day, the traveler said:

"I never could stand living out here. You don't see anything. You don't travel like I do. I'm going all the time."

The old man on the fence looked down at the stranger slowly and then he drawled:

"I can't see much difference in what I'm doing and what you're doing. I sit on the fence and watch the autos go by, and you sit in your auto and watch the fences go by. It's just the way you look at things."

* * *

"And now, children," inquired the Sunday School teacher, in a review of the day's lesson, "who can tell me what we must do before we expect forgiveness of sin?"

There was a moment's pause, and then little Wilbur made his logical contribution: "Well," he said, "first we have got to sin."

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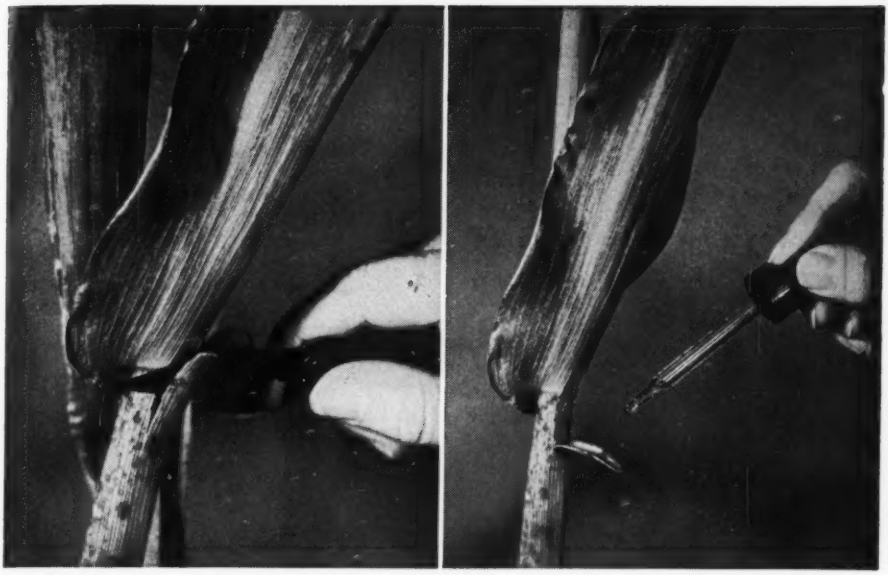

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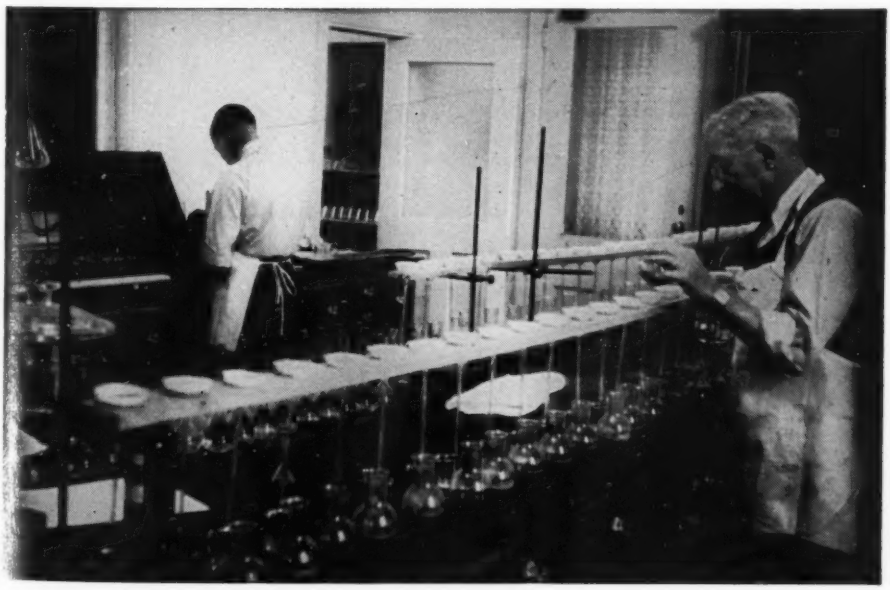

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